THE MEDICAL JOURNAL OF AUSTRALIA

VOL. I.—29TH YEAR. SYDNEY, SATURDAY, FEBRUARY 21, 1942. No. 8.

Table of Contents.

[The Whole of the Literary Matter in THE MEDICAL JOURNAL OF AUSTRALIA is Copyright.]

ORIGINAL ARTICLES— Page.
The Halford Oration—The Ancillary Sciences and Neuro-Surgery, by Harold R. Dew, F.R.C.S. .. 215
The Measurement of the Cardiac Output: An Investigation into the Acetylene Method, by Matthew Morrissey .. 221
Antileucocytic Sheep Serum as Sensitizing Agent in Chronic Myeloid Leuchæmia Refractory to Deep X-Ray Therapy, by J. B. Thiersch 225

REPORTS OF CASES—
Gonococcal Meningitis, by Jean Armytage, M.B., B.S. 229

REVIEWS—
Surgery of the Heart .. 230
Physical Diagnosis .. 230

LEADING ARTICLES—
Neuro-Surgery in Australia .. 231

CURRENT COMMENT—
Air Raids and Injuries to the Eye .. 232

ABSTRACTS FROM MEDICAL LITERATURE—
Ophthalmology .. 234
Oto-Rhino-Laryngology .. 234

MEDICAL SOCIETIES—
The Australian Orthopædic Association .. 239

BRITISH MEDICAL ASSOCIATION NEWS— Page.
Scientific .. 236
Medico-Political .. 238
Victorian Branch News .. 239

NATIONAL EMERGENCY MEASURES—
Medical Equipment .. 243

CORRESPONDENCE—
Herpes Recurrens .. 243

NAVAL, MILITARY AND AIR FORCE—
Appointments .. 243
Casualty .. 244

MEDICAL WAR RELIEF FUND .. 244

AUSTRALIAN MEDICAL BOARD PROCEEDINGS—
Tasmania .. 244

OBITUARY—
William Booker Vance .. 244

NOMINATIONS AND ELECTIONS .. 244

DIARY FOR THE MONTH .. 244

MEDICAL APPOINTMENTS: IMPORTANT NOTICE .. 244

EDITORIAL NOTICES .. 244

The Halford Oration.[1]

THE ANCILLARY SCIENCES AND NEURO-SURGERY.

By HAROLD R. DEW, F.R.C.S.,
Professor of Surgery, University of Sydney

I SHOULD like to express my appreciation of the honour which has been conferred on me by the invitation to deliver this oration in memory of George Britton Halford, the founder of the great medical school from which I graduated.

It is with some diffidence that I approach the task of attempting to maintain the high standard set by previous orators, particularly as a number of them have been my teachers; but I hope that I may be able to interest you in some of the recent developments which have taken place in a special field of medical science—developments that would have delighted Halford had he been alive to witness them.

To all who are interested in the scientific side of medicine, the story of Halford's life and interests, of his early difficulties and final triumphs, not only in his own particular field but in the wider one of medical education, is a constant stimulus. He came to Melbourne in 1862 to take complete charge of and initiate a new medical school and at once began teaching physiology, anatomy and pathology. This, owing to the surprising advances in these subjects, would be quite beyond the compass of any one man today, and the fact that he did so is evidence of the limited scope of these subjects in those days. Although facilities for research in the way of laboratories, apparatus, accurate physical and chemical methods and all that goes to make a modern research department, were almost entirely lacking, he managed, early in his career, to undertake a number of original researches on such diverse subjects as the physiology of cardiac action, the effect of snake venom, human histology and comparative anatomy. That he was able to do so much original work is a tribute to his enthusiasm and genius and a confirmation of the opinion expressed by Paget and Owen at the time of his appointment.

Previous lecturers have dealt with his contributions to medical science at some length, and all emphasize that he was a firm disciple of the experimental method, which had been steadily developing in the medical sciences since the time of Harvey. Halford thus joined the long procession of scientific workers who have devoted their lives to the problems of disease and the unveiling of nature's secrets. Medicine and humanity are indeed indebted to these restless spirits who, driven by a dominating passion and an insatiable curiosity to find out the truth, never rest contented until they have added something of value to the sum of human knowledge. The individual stimulus and efforts of men like this play a much larger part in scientific progress than the collective effort of multitudes of ordinary men. They have been called the "ferment" folk, and although they differ widely amongst themselves, they all have, like Halford, the gift of personality, of human sympathy and of interest in the work of others.

In these days of intense nationalism, of jealousies between social classes, of commercial and political opportunism, the ideals and aspirations of the research worker come as a refreshing breeze. Some people exalt the successful soldier, others the financier, others the narrow-minded nationalist, and the ordinary unthinking ones often find

[1] Delivered on November 27, 1941, at the Australian Institute of Anatomy, Canberra.

their heroes among the film stars; but medical science grants its badge of greatness only to those who, often with little hope or care for recompense, find their intellectual satisfaction in the search for the elusive secrets which may benefit mankind. Halford was of this breed, and he left behind him a pattern and an ideal which, permeating among his pupils, have had a remarkable influence upon the medical school he founded.

The Experimental Method.

The application of the experimental method to the biological sciences has developed greatly during the past fifty years, and had Halford been alive today he would be amazed at the progress made.

We have seen extraordinary developments in scientific knowledge and methods and the bringing to light of new phenomena, often completely unpredictable from the rigidly mechanical conceptions of the nineteenth century, which have taught scientists a new modesty and the need to avoid dogmatic assertions without knowledge. There has been a growing exchange of views and methods between the various branches of science, and this new coordination has been so productive that the contributions of the last sixty years have exceeded greatly in number and significance those of the previous 4,000 years.

Medicine, too, has become much more completely international; more than any others its workers speak a common scientific language, they are inspired by a common humanitarian function, and they are in such close communication with each other through the numerous journals that doctors in our laboratories and hospitals have knowledge of and access to discoveries, wherever they may be made, within a few weeks.

The history of this period has been the gradual evolution of new concepts from previously known facts, the making of new observations and then experimental attack upon them in the laboratory followed by their clinical application. The clinician garners and sorts out technical developments and information from all available sources, tests and checks them, explores all fallacies and dangers, and once their value is proved transmits them to the profession generally.

The clinician must always play a very important part, and because he alone can see the problem and its solution in proper perspective and has the responsibility of applying the findings to the human subject, this is often a dominant one. This application frequently calls for the same careful experimental approach as that of a laboratory experiment. One must deprecate the tendency in some quarters to over-emphasize the importance of purely laboratory experiments as compared to clinical methods; however different the technique, both are alike important, and where the study of disease processes is concerned they will always be complementary to each other. During his daily work the practising doctor meets many special, puzzling or transient manifestations of disease, any of which may point the way to a new advance. He therefore often finds the problem, and whatever else may lie between in the way of experiment or investigation, the final stage of application to human disease is again also clinical. I hope to show that in this way the neuro-surgeon, particularly both as experimenter and as clinical observer, is playing an increasingly important part in the elucidation of many neurological problems.

The experimental method has been brilliantly successful in the hands of numerous workers; it is not dependent upon blind chance, but on constructive hypotheses based on previous knowledge, and with due observance of well-established principles and techniques, it has been responsible for much that makes modern civilization possible. Without it, we should today (to mention but a few) be without modern bacteriology and immunology, toxins and antitoxins, asepsis and antiseptics, anæsthesia, insulin, sulphanilamide and the numerous medical and surgical procedures which are so taken for granted by all of us.

Much of this work on the biological side has been undertaken on animals; yet we still find ignorant people condemning animal experimentation, in spite of the millions of lives that have been thus indirectly saved. The world should not forget that many doctors like Lazear, Ricketts, Manson and Haldane, to mention but a few, have not hesitated to use their own bodies experimentally, sometimes with fatal results, in order that mankind may be served. Many workers have contributed to the biological mosaic that makes up medical science, and while many of them are unknown to fame, one has to remember that scraps of apparently unimportant information may become first fundamental and later useful; that another man may be able to utilize a seemingly unimportant fact; and that biological knowledge is often acquired out of sequence, as it were, so that time may be needed before facts can be put in their proper setting.

The importance of facts which are apparently of academic interest only or unrelated to anything useful, cannot be overestimated, and many of the most outstanding developments in all branches of science have been based on such work.

One of the greatest discoveries of science was made by Faraday—one of the most original experimentalists that has ever lived—when he found, by a very simple experiment, that an electric current could be induced in a coil of wire by mechanical movement of an electro-magnet. On this simple discovery are based all the developments of electric power and the utilization of electricity that we have around us today, and Faraday for a time alone realized its import. A distinguished lady who saw his demonstration at the Royal Institution in London asked: "What is the use of this fact?" And Faraday made the famous reply: "Madam! What is the use of a newly born baby?"

No one who is at all informed can doubt that the physical, chemical and biological sciences are the foundation on which the wonderful edifice of modern medicine has been erected, and I wish to draw your attention to some of the ways in which we are using them for the cure of human ills.

The Experimental Method and Neuro-Surgery.

For some years the members of my department in Sydney have been particularly interested in the surgery of the brain and spinal cord. The rise of this special branch of surgery is comparatively recent, within the lifetime of most of us, and thanks to the combined efforts in many countries of experimenting physiologists, neurologists and neuro-surgeons it is now firmly established. Harvey Cushing, the great American surgeon, played by far the greatest part, not only in investigating many underlying problems of disease of the central nervous system, but also in evolving operative methods and in training a school of neuro-surgeons whose influence is now world wide.

In this country we had a good deal of leeway to make up; but we have now passed the adolescent stage, and have not only established diagnosis and treatment at a high level, but have also begun to add our quota to the more fundamental and experimental side. We are greatly indebted to the many discoveries made in the ancillary sciences, and in no field of surgery have they played a more important part in the development of new methods of diagnosis and treatment. Furthermore, because every surgical operation on the brain or cord is partially experimental, because no two lesions are exactly the same in their effects, nor are two patients exactly the same in their behaviour, neuro-surgeons have an unrivalled opportunity, which they have not neglected, of extending our knowledge of the functions of this important system.

The Cerebro-Spinal Fluid.

The cerebro-spinal fluid is produced at a normal pressure of 100 to 180 millimetres of water by the vascular choroid plexuses within the cerebral ventricles, and circulating around the brain and spinal cord, passes into various expansions or cisternæ of the subarachnoid space. The problems of this circulation and its vagaries have been investigated by numerous experimentalists, among whom Dandy and Cushing are outstanding, and there is now a constantly growing voluminous literature on the subject.

The work of Dandy established its site of production and the mechanism of its regular absorption into the blood stream of the dural venous sinuses.

This third circulation, as Cushing so aptly described it, is very active and very important, and acts as a flushing and buffer mechanism, while any obstruction to its main pathways is at once manifested by a general rise of intracranial pressure—often by the production of hydrocephalus.

By lumbar puncture the pressure of the fluid in various postures and in all sorts of conditions can be measured, while its chemical and cellular properties can also be ascertained. High pressures up to 400 millimetres or more of water are found in such diseases as tumour, which interfere with the absorption of the fluid, or in cases of brain injury, when cerebral œdema produces similar effects.

It was soon found that high pressure inside the ventricles not only produced hydrocephalus and pressure effects, but made lumbar puncture dangerous if much fluid was removed, because the crowding of the brain downwards into the *foramen magnum* sometimes produced a pressure cone with complete block of the ventricular system and the institution of a vicious cycle of increasing pressure culminating in death. Reid,[2] working in Montreal with Cone, has proved and emphasized the importance also of herniation of the medial part of the hemispheres through the *incisura tentorii* and has shown that this tentorial cone often explains the peculiar pupillary signs sometimes seen in cases of high intracranial pressure or of spreading cerebral œdema. He has continued this work and has also carried out experiments in my laboratories on the rapid and gradual compression effects of artificially produced tumours made by a small inflated balloon or by the imbibition of water by certain seeds. This has been combined with ventriculographic and histological studies, with some very interesting results.

Morson, another research worker in the department, has attempted to clear up the vexed questions of the importance of blockage of the vein of Galen in the production of internal hydrocephalus. While as yet inconclusive, his experiments will when finished undoubtedly clear up this problem.

Among the experimenters in America, Weed[3] and co-workers discovered that the intravenous injection of hypertonic saline or glucose solution would rapidly reduce the pressure of the cerebro-spinal fluid. It was discovered, too, that ingestion by mouth or rectal injection of concentrated solutions of magnesium sulphate could have the same effect. This discovery was then applied to the treatment of patients with cerebral œdema and other conditions associated with high pressure. Many interesting and at times conflicting reports were soon available; but the method has now found its right place and its limitations, and risks have been assessed.

Ellis[4] and Phillips, in Sydney, have studied the effect of these hypertonic solutions at some length, particularly in cases of bruising and compression of the brain. They have devised an apparatus which they call a cottunometer for automatically recording the cerebro-spinal fluid pressure quantitatively, over long periods of time and during treatment by various agents. This is done under strict aseptic precautions. The fluid pressure is conducted by air tubing to a small rubber tampon, which carries a small front-silvered mirror reflecting a spot of light onto slowly moving sensitized paper. The machine is, of course, previously calibrated against a fixed base line by means of a water manometer.

This has given us very important information about the degree of and duration of the effects produced by raised venous pressure, the intravenous administration of hypertonic solutions, rectal injections and repeated lumbar punctures *et cetera*—knowledge which is of the greatest value in the treatment of brain injuries in particular.

The neuro-surgeon has not been slow to take advantage of this knowledge, and not only has he used this in the management of patients with high pressure, but he has been able to confirm many of the observations at operation. Information has also come from clinical observations of dislocation effects, decompression operations, ventricular puncture, and operative attacks on the chorioid plexuses or the aqueduct of Sylvius, while the effects of inhalation of carbon dioxide and of secondary vascular changes have all been investigated.

Intelligent brain surgery demands a full understanding of the physiological principles involved in high intracranial pressure. These include the mechanism of production of cerebro-spinal fluid and of obstructive dilatation of the ventricles, the importance of the rigid falx and tentorium and the *foramen magnum* in such cases, and the use and dangers of indiscriminate puncture or decompression.

Localization of Function in the Cerebral Hemispheres.

It has been known from early times that injury to certain parts of the brain and spinal cord would produce functional defects such as paralysis. The gradual accumulation of exact knowledge concerning the localization of specific function in various parts of the nervous system is due to the work of numerous experimenters. Fritsch and Hitzig (1870) first found that it was possible, by means of weak electric currents, to excite parts of the cerebral cortex and produce muscular contractions. They were followed by Ferrier, who, using monkeys, mapped out the excitable motor cortex. He demonstrated in Paris in 1874 a monkey which had been made hemiplegic by excision of part of the contralateral motor area. The dramatic impact of this work on the physiologists and clinicians of the time was reflected in the remark of the great Charcot who, when he saw how closely the animal's behaviour coincided with that of human patients with hemiplegia, exclaimed: "It is a patient."

The work of Hughlings Jackson on focal epilepsy in human subjects and the experimental work of Horsley on monkeys confirmed and extended our knowledge of the motor and sensory cortex. Clarke, early in the century, introduced one of the most ingenious instruments yet devised—the stereotactometer—by which it is possible by electrical methods to produce small localized lesions at any depth or at any point of the brain of a laboratory animal. Much work on the function of the deep nuclei of the brain has been made possible by this instrument.

Concurrently with this experimental work, comparative anatomists and histologists carried out numerous and laborious studies on the finer structure of the brain. The work of such men as Brodmann and Campbell along these lines initiated a new branch of neuro-anatomy called architectonics, which is concerned not only with structure but also with the division of the brain into areas of specific structure. This work was made possible only by the skilful use of new staining methods introduced mainly by Golgi and Cajal and by accurate observation of the distribution of degeneration effects following experimental excision of various regions. The literature of this subject is now very large and is still being added to, and the known facts are being correlated with discoveries in the other fields of neurological research. It seemed probable that such variation in structure was associated with variations in function, and this was soon put to the test by the experimental physiologist. Work on animals was carried out in many countries and received a great impetus when the higher apes became available for detailed study. The work of Sherrington and his school in England and of Fulton and his co-workers in America has been particularly productive of results, and has thrown much light on cerebral function, particularly of the parietal and frontal areas.

It was soon realized that inarticulate animals had a limited value when it came to the interpretation of the effects produced by cerebral lesions, and confirmation or otherwise had to be obtained from human sources. The great neurologists of the Continent and England, too numerous to mention, by accurate observation of series of patients followed by pathological studies, gradually differentiated centres for hearing, speech, word blindness, writing and smell, while perimetric investigations by ophthalmologists correlated with operative and pathological evidence enabled the occipital visual cortex to be mapped out. The function of the deep nuclei of the

cerebrum, of the cerebellum and of the tracts of the spinal cord were also investigated both by experiment and by correlation of clinical and autopsy findings.

There still remained large areas, particularly in the frontal and temporal lobes of the cerebrum, whose exact function remained obscure, and which were classed as quiet areas of association, of memory, of temperament, or of the higher intellectual faculties.

All this information has been obtained and coordinated from the work of experimenters, clinicians, pathologists and anatomists, and the results achieved illustrate very well the value of such a combined attack.

Once the brain became safe for surgery with the development of better diagnostic and surgical methods, operative exposure of the brain became frequent and the neurological surgeon assumed an important place in the elucidation of these interesting functions. He had, in addition, the great advantage of a human subject, in whom the results of stimulation or excision could easily be followed and interpreted with an accuracy which is quite impossible with any animal.

New electrical techniques have given us accurate, graded methods of stimulation, so that the effect can be limited absolutely to small areas, and neuro-surgeons today constantly use methods of cortical stimulation for localization purposes. Recently Gardiner and Phillips, in my laboratory, devised a new thyroton stimulator for this purpose. This works on the principle of an intermittent discharge of a condenser through a thyroton valve when the charge reaches a certain level. The cycle is repeated indefinitely and a fluctuating current of any intensity or frequency can be readily produced.

Using similar electrical methods, Cushing stimulated the post-central gyrus of conscious patients and properly mapped out the sensory area of the cortex. Later it was found that epileptogenic foci producing Jacksonian epilepsy could occur at variable distances from the motor area and that surgical excision of these scarred areas would sometimes cure the seizures. This led to a determined surgical attack on these distressing cases, particularly by Foerster and Penfield. Penfield, of Montreal,[4] who operates under local anæsthesia, has thus been able to make hundreds of stimulation experiments on conscious patients; his work has revolutionized our knowledge particularly of the premotor cortex, and his accurate charts will probably supersede all others. His last series records the findings in 126 cases and is a monumental piece of applied research. This has been one of the greatest contributions of modern neurosurgery to the physiology of the human brain.

The study of the effects of war injuries to the brain with the loss of some portion of the cortex has taught us much; but the more recent work of neuro-surgeons in excising portions of the brain, either as a stage in the removal of a tumour or as a deliberate excision of cysts or scars, has taught us much more. Relatively large portions, up to a whole right hemisphere, have been successfully removed, and series of cases have been accurately recorded, particularly by Dandy, Jefferson and Penfield.

The surprising fact emerged that it was possible to remove large amounts of the frontal lobes without any apparent effect on the mentality, temperament or behaviour of the individual, in spite of the fact that tumours in the excised area produced clinical changes in these directions. Careful psychological and neurological studies both before and after these lobectomies have and are still being made, and the results indicate that we shall have to make a complete review of our opinions as to the finer functions of this area of the brain.

A growing appreciation of the remarkable degree of compensation that can take place in brain function, and of the possibility of the transference of function to undamaged areas, has had an important influence on our interpretation of clinical findings.

It has also been found that, although certain functions may be lost, removal of a complete right half of the cerebrum excluding the deep nuclei is quite compatible with life for months or even years. In the same way it has been demonstrated that ablation of a large part of the cerebellar cortex, if the deep nuclei are respected, produces no permanent instability or other effect. As a matter of fact, neuro-surgeons often deliberately remove one-third of a normal cerebellar lobe in order to gain full access to tumours of the cerebello-pontine angle.

These findings are being added to every day, and hardly a month goes by without some new case record from some neuro-surgical clinic of the results of removal of large portions of the brain. We ourselves have quite a number of patients on whom this has been performed, and defy any one to detect which patients they are by ordinary clinical examination.

Penfield,[5] who has had the unique experience of removing the frontal lobe of his only sister, made a special record of this very tragic case as well as of a number of others, and may be quoted:

> Large amputations of the frontal lobe, if the precentral gyrus be left intact, produce surprisingly little disturbance of function that can be detected by ordinary methods of examination. Many of the patients were able to return to their work and activities, although in some of them there may have been lessening of initiative and capacity for planned action.

The Spinal Cord.

The spinal cord, too, is often affected by injury or by the pressure of tumours and other lesions, so that an understanding of its function is of prime importance. Very early in the history of physiology, Bell and Magendie discovered the basic motor and sensory functions of the spinal nerves and their roots, and soon experimentalists began to explore the cord functions in the laboratory animal. We are particularly indebted to Sherrington and his school as well as to a number of other British physiologists for an understanding of spinal reflex activity, of reciprocal innervation, of the visceral reflexes and of the effects of partial and complete spinal cord section. This work has been amplified by histological studies on the connexions of the various tracts, by studies in comparative anatomy and by numerous confirmations at autopsy of carefully observed diseases affecting the cord. The neuro-surgeon, using all this accumulated knowledge and new methods of diagnosis, is now able to diagnose with complete confidence the site of injuries and pressure by tumours and similar lesions and to apply the findings to the treatment of his patients. In addition, he has been able at operation to confirm many observations based on experiment, to describe new syndromes such as that of a dislocated *nucleus pulposus*, and to introduce new procedures such as chordotomy for the relief of intractable peripheral pain. Space does not permit of any detailed consideration of the interesting developments in spinal cord physiology and surgery; but the work of accurate observation by physiologist, anatomist, neurologist and neuro-surgeon still goes on.

The Pituitary Gland and its Functions.

The function of the pituitary gland was for long shrouded in mystery; but now, thanks to the work of numerous experimenters and its correlation with clinical observations, most of the problems are solved. Well into this century it was not fully realized that the typical sideshow exhibits—the giant, the dwarf, the bearded woman and the fat boy—practically all represented abnormalities of development due to disordered pituitary function. Gradually the same experimental methods as were used with such success in the study of the other ductless glands, particularly observations of the effects of removal of part or whole of the gland and of the injection of extracts obtained from it, were applied to this organ. Cushing and his co-workers, Dandy and Reichert, were early in the field, and as they were all neuro-surgeons they were able with great profit to compare their experimental work with their clinical and operative experiences. Out of this jumble of experimental and clinical observations order has come at last. Many branches of medical science have thus made contributions; physiologists and biochemists have studied the extracts of the glands from

various animals, morphologists have explored its development, and experimenters in many countries have shown the effects of destructive lesions of the gland and nearby centres.

Most of their findings have been confirmed by neurologists, ophthalmologists and neuro-surgeons; the last-mentioned especially, because of the increasing number of surgical operations on this region, have added much to our understanding of the protean manifestations of disease of this insignificant-looking organ. There is no example in the whole realm of medicine which illustrates better the way in which knowledge from many different sources has been correlated to give solutions of what at one time appeared to be insoluble clinical problems.

Radiography.

When the physicist Röntgen, while working with a Crookes's vacuum tube covered with opaque paper, discovered almost by accident the penetrating rays that we know as the X rays, his acute mind—particularly acute because of his experimental training—at once grasped the significance of his discovery. Neither he nor his contemporaries, however, dreamed how important the use of these rays were to become in the diagnosis of disease and in the amelioration of human ills. The characteristics of these rays were soon discovered, and reliable and accurate methods of using them were evolved. Neurologists found that X-ray photography, by revealing bony changes in the skull, the presence of abnormal calcified areas or a shift of the pineal shadow, often gave useful if limited information, and clinicians, who had this field to themselves, made the most of it.

The next big advance came when in 1918 Dandy, in Baltimore, during his attempts to alleviate the condition of many patients with congenital hydrocephalus of hopeless prognosis, introduced some air into the lateral ventricles, which were thus shown in outline in subsequent radiographs. He at once saw the value of his observations and evolved the technique of ventriculography. Many trials and experiments were needed before the dangers and the fallacies of the method were ascertained; but now, thanks to him, we have an efficient and accurate method of diagnosis of the great majority of intracranial lesions. An immense number of interpretations of distortion or deformation of the ventricular system due to the presence of tumours and other lesions has now been recorded, and the method has been perfected, standardized and made safe. Today, sometimes with the use of oxygen or ethylene instead of air, this method of examination, though not so necessary as in the early days of neurological surgery, still remains the most reliable method of diagnosis in difficult cases.

By the introduction of the air into the lumbar thecal space it was found that, while some of the air rose and entered and outlined the ventricles, a great deal spread in the subarachnoid space over the cortex and outlined the cerebral sulci. Cautious experiment soon showed that this method had considerable value, particularly in cases of Jacksonian epilepsy due to old injury, in which scars, adhesions or atrophic areas were present. These encephalograms are, of course, difficult to interpret, but are of great diagnostic value in some cases. The experimental chemist then entered the picture and introduced medicine to substances, notably "Thorotrast", which were opaque to the X rays and relatively inert and harmless in the body. This compound of the thorium was first used by Monez and Limas to delineate the arteries of the brain, and so the technique of cerebral arteriography was evolved at first in the laboratory animal and then in man. This has proved of great value in the diagnosis of aneurysm of the cerebral vessels; but much experience and skilled interpretation are needed for it to be of much value in other lesions.

A further chemical contribution came when Sicard and Forestier introduced iodized poppy oil or lipiodol, which, heavier than water, is radio-opaque. This substance is non-toxic and can be introduced into the spinal canal, from whence its flow can be directed by posture. Its use has revolutionized the diagnosis of tumours *et cetera* of the spinal cord, as it is possible to detect the exact location and degree of deformation and blockage produced by lesions in and around the cord. It is also often possible by this means to delineate the chiasmal area by filling the basal cistern with lipiodol by gravity, and this will undoubtedly help in the differential diagnosis of lesions in this difficult region.

All these methods have been extended and developed by experiment, while the neuro-surgeon has learnt how to interpret them in the human subject and has confirmed the findings at operation or at autopsy, so that great improvement in diagnosis has resulted. Not only does our localization of space-occupying lesions of the central nervous system equal in accuracy that of the urologist in lesions of the kidney, but owing to extensive studies by neuro-surgeons of the regional incidence of all sorts of lesions we can today, with increasing confidence and with a high degree of accuracy, foretell what type of lesion to expect. From the point of view of both patient and surgeon, this is a great advance.

Electrical Recording Methods.

More recently the newer development in physics and in electrical technique has been called to the aid of biological science. The often repeated criticism of biological methods, that they lacked the accurate measurement so revered by the more exact sciences, is at present being effectively answered. Too often in the past we have had to be content with the statement that an experimental response was simply absent or present or larger or smaller; but now we can often measure these responses and state exactly how much they differ. Thanks to the application of the principle of quantitative and proportional amplification of tiny electric currents made possible by the remarkable advances in radiophysics, neurological experimenters now have new and valuable methods at their disposal. Not long ago the distinguished physicist Fleming was investigating a problem of apparently little practical application—the deposition of metallic film in vacuum tubes, rather like that seen in metallic filament electric light globes. He quite unexpectedly hit upon the principle of the thermionic valve, upon which all modern wireless telephonic and broadcasting technique is based. Much experimentation followed, and we now have available a great variety of similar valves for all sorts of amplification purposes. It is a far cry from all this to the problems of action currents in nerve and muscle, to nystagmus or to the diagnosis of epilepsy and tumours of the brain; but the results of this discovery are revolutionizing our knowledge of these things. It is another good example of how an apparently purely academic discovery in one field of science can be applied to advance knowledge in an entirely unrelated field. Physiologists have long known that the passage of a nerve impulse, a muscular contraction, glandular activity, and in fact cellular activity in any tissue, are all associated with the production of small changes of electric potential and so tiny electric currents. This is particularly the case in the central nervous system, where all activity is accompanied by such changes of electric potential. These very small currents are called "action currents"; the smallest of them range in intensity from 10 to 100 millionths of a volt, and until quite recently they could just be detected by the most delicate galvanometers, actual measurement and accurate comparative and quantitative study being quite impossible. Now, thanks to the work of the physicists, we can pick up these tiny currents and amplify them proportionately by a system of valves, until they can be used to move accurately calibrated recording instruments. This method was first applied to muscles and peripheral nerves, and we are largely indebted to Adrian and Matthews, of the Cambridge School of Physiology, for opening up this new experimental field. This type of work has now, of course, been repeated and extended in laboratories all over the world, and has led to great advances in neuro-physiology—far beyond the wildest expectations of a decade ago. The method is also being applied to all sorts of biological

phenomena, so that the field of application is constantly widening. The method used varies with the intensity of the current; the muscle action currents, being the strongest, can be measured relatively easily, and for long this has been done in the case of the heart muscle by the electrocardiograph—an apparatus which, as standardized as an ordinary wireless set, is now being used daily by numerous physicians. In the case of nerve action currents, which are hundreds of times weaker (microvolts rather than millivolts), more complicated and delicate methods have to be used. Interference has to be carefully guarded against, and this means the complete screening of the apparatus from extraneous sources by means of a cage of metallic netting. We have had the greatest difficulty in our laboratories in overcoming interferences from lifts, rotary transformers and motor lawn mowers working nearby. The action currents are picked up with non-polarized electrodes, proportionately amplified and led to a detecting and recording mechanism. These, too, are beautiful instruments. At times we use the Cambridge string galvanometer, more commonly the Matthews mirror oscillograph and at other times the more delicate but rather lively cathode ray oscillograph.

The response of all of these detectors can be recorded photographically on moving sensitized film or paper, and accurate calibration and so accurate measurement can be carried out. At the same time the amplified current can be led to a loud speaker or microphone and audible signals detected, put on a gramophone record or used to move an automatic ink writer.

In my department we have been interested in action currents from the retina and the eye muscles and particularly in the problem of nystagmus. McIntyre,[8] using the fact that the eye ball is polarized, that movement induces a current which can be picked up by electrodes led off from the temples, and that nystagmus is easy to induce both in monkeys and in human subjects, has been able to solve many of the outstanding problems connected with this interesting phenomenon. By making use of amplification and oscillographic methods, he has been able to record simultaneously action currents from the various ocular muscles and the motor discharge from the sixth cranial nerve. These have been accurately timed and measured, and he has proved conclusively that the rhythm of nystagmus is entirely central in origin and is independent of impulses from the ocular muscles themselves, thus settling a physiological controversy of very long standing. This work is being proceeded with along similar lines, but particularly now in relationship with aviation medicine, which has opened up a completely new field.

A further development took place when action currents from the normal brain were detected by Berger. Their intensity varies from 10 to 100 millionths of a volt, and they consist of both α (Berger rhythm) waves from eight to twelve per second, and β waves from 18 to 30 per second, these figures varying with individual subjects and with the activity of the brain. These required very special amplification for their detection and comparison; but the technique of electro-encephalography was soon developed, particularly in England and America, and thousands of records have been studied. The technique has passed the experimental stage, and the apparatus is now in use as a routine method in all modern neuro-surgical units. The method is new and interpretation is difficult; but it makes a fascinating study, and we are now at the stage of learning its fallacies and its accurate application. Its greatest value so far has been in the study of epilepsy of various types and in the localization of irritable foci due to tumours or abscesses. The deductions made from its use are, of course, continually being confirmed by operative findings. With continued experience and improvements in our technique—matters which depend on experimentation—the method promises to become quite as valuable in the study of brain lesions as electrocardiography in diseases of the heart.

Another advance which we owe to the electrical technician is the application of high voltage current of rapid alternations to the problem of the control of hæmorrhage, and the coagulation of neoplastic tissue and its relatively bloodless removal. All this has been made possible by the development of the modern surgical diathermic unit which, first applied by Cushing to the surgical attack on vascular brain tumours, is now a standard part of our armamentarium.

Conclusion.

There are many other aspects of neurological physiology, particularly that of the peripheral nerves and of the sympathetic system, in which the experimental method has had a dominating influence. This work, to which Australian experimenters like Hunter and Royle added so much, has been carried out by thousands of experimenters in all parts of the world, and has been coordinated with the results of clinical and operative experience, so that our knowledge of the physiology of this section of the system is now very complete.

Time does not permit a consideration of the work of the physiological research workers who, particularly in England under the stimulus of Horsley, Sherrington, Dale, Lewis, Adrian and others, basing their deductions almost entirely on the experimental method, have added so much to the fundamental knowledge of this subject. Nor must one forget the countless observations made by unknown or forgotten workers who, gaining little or no personal recognition, have played such a large part in the accumulation of facts which have gradually been fitted into their correct setting.

The art of the neurological surgeon has developed to a high level, and we have reached this level by climbing upon the shoulders of numberless experimenters in all the ancillary sciences. Our advances have been due to the application of results obtained by many workers—by the physicist, the chemist, the physiologist, the pathologist, and finally by the clinical neurologist or surgeon. Had it not been for the work of all these scientists, we should not have today electrical methods, fine optical or steel instruments, the ophthalmoscope, radiography, modern antiseptics and modern diagnostic methods, and we might still, like paleolithic man or the trephiners of New Britain, be laboriously filing a hole with a piece of obsidian in an attempt to let out evil spirits which were for long held to cause these diseases.

I have tried to illustrate how medical science in this special field is advancing, how the experimental method remains, as in Halford's day, the most important method of attack upon a new problem, how a purely accidental or academic discovery may prove to be of the greatest practical use later on, and how there cannot be a divorce between laboratory and clinical methods. What the future holds for medical science we do not know; but there is no doubt that our children will see still greater advances, and that these will largely depend upon the way in which we utilize knowledge from all branches of science for our attack on the problems of disease.

References.

(1) W. L. Reid: "Cerebral Herniation through Incisura Tentorii; Clinical, Pathological and Experimental Study", *Surgery*, Volume VIII, Number 5, November, 1940, page 756.

(2) L. H. Weed: "The Effects of Hypnotic Solutions upon the Cell-Morphology of the Choroid Plexuses and Central Nervous System", *The American Journal of Anatomy*, Volume XXXII, 1923-1924, page 253.

(3) F. F. Ellis: "Method for Continuous Recording of Cerebrospinal Fluid Levels: Preliminary Report on Effects of Intravenous Therapy in Treatment of Cerebral Œdema", *The Australian and New Zealand Journal of Surgery*, Volume X, Number 1, July, 1940, page 20.

(4) W. Penfield and E. Boldrey: "Somatic Motor and Sensory Representation in Cerebral Cortex of Man as Studied by Electrical Stimulation", *Brain*, Volume LX, part 4, December, 1937, page 389.

(5) W. Penfield and D. Hebb: "Human Behavior after Extensive Bilateral Removal from Frontal Lobes", *Archives of Neurology and Psychiatry*, Volume XLIV, August, 1940, page 421.

(6) A. K. McIntyre: "Quick Component of Nystagmus", *The Journal of Physiology*, Volume XCVII, Number 1, 1939, page 8.

THE MEASUREMENT OF THE CARDIAC OUTPUT: AN INVESTIGATION INTO THE ACETYLENE METHOD.

By MATTHEW MORRISSEY,

From the Department of Medicine, University of Sydney.

THE cardiac ouput is the volume of blood, in litres, pumped out in one minute by the left ventricle of the heart, and for its determination are required the values for the arterio-venous oxygen difference or the arterio-venous carbon dioxide difference, together with the corresponding figures for either the oxygen or carbon dioxide respiratory exchange. The terms "minute volume" and "circulatory minute volume of the heart" are synonymous with cardiac output; but they are ambiguous, and to some connote a relationship, quite unwarranted, with the blood volume and with the velocity of the blood stream, and for this reason they will not be used in this paper.

If a certain known volume of fluid is flowing through a system and either giving up or taking up gas, then, if the volume of gas taken up or given out by unit volume of the fluid as it traverses the system, and also the total volume of gas involved in the transference in unit time, are known with accuracy, it is a simple matter to compute the volume of fluid flowing through the system in such unit time.

It was Fick[1] who in 1870 first suggested that this principle could be applied to the heart, and it has come to be known as the Fick principle. Essentially it is:

$C.O. = \frac{R.E.}{A.V.D.}$, where *C.O.* is the cardiac output in litres, *R.E.* is the respiratory exchange per minute and *A.V.D.* is the arterio-venous difference.

Figures for the solution of the equation can be obtained directly by puncture of the right side of the heart, followed some short time later by arterial puncture (as has been done in human subjects by Baumann and Lauter and Friedländer,[2,3] by Baumann and Grollman,[4] and by McGuire, Hauenstein and Shore[5,6]) with removal and direct analysis of the blood gases, the difference in volumes *per centum* between the two samples being the *A.V.D.* of the above equation.

The respiratory exchange is determined by the ordinary Douglas bag method. It is not possible to substitute venipuncture for heart puncture in the direct method as outlined above, for it has long been known that the gaseous content of the blood from one vein may bear little relationship to the gaseous content of the mixed venous blood, being influenced by the metabolic state of the organ or limb and by the relative dilatation or constriction of the capillary bed through which it has passed. Indeed, Meakins and Davies[7,8] have shown that exposure of a limb to severe cold may result in the complete oxygen desaturation of its venous blood.

Although providing in Grollman's hands spectacular confirmation of his own acetylene method, later to be described, the direct application of Fick's principle is, of course, not a method lightly to be undertaken, nor one which can find application in the ordinary investigation of the heart even in normal subjects, and its obvious disabilities forbid completely its use in subjects who have any cardiac disorder. Recourse has been had to various indirect methods based on Fick's principle, all of which necessitate the accurate determination of the alveolar and venous tensions of either oxygen or carbon dioxide and the conversion of these figures to volumes *per centum*, either by equilibration of the subject's blood with gases of similar tensions and subsequent analysis, or by reference to a dissociation curve. Because of the ease with which carbon dioxide can be analysed, methods based on this gas have been widely tried, and a subsequent paper will be concerned with a criticism and elaboration of these methods.

There are various other indirect methods involving analysis of respired gases; but these are based not so much on Fick's principle as on the foreign gas principle of Bornstein, the basic assumption being that the pulmonary blood flow, which is of course equal to the cardiac output in all but a few rarely met with subjects, determines the rate at which a foreign gas can be absorbed, provided that its tension and absorption coefficient are known. Bornstein himself used nitrogen, which is foreign only in the sense that it is physiologically inert; but the principle was applied by Krogh and Lindhard, who used nitrous oxide, by Henderson and Haggard (ethyl iodide), by Marshall and Grollman (ethylene), and by Grollman (acetylene).

The Acetylene Method.

It is quite unnecessary to review the voluminous literature which has grown up around the subject of cardiac output, for this has been done by Grollman; but of all methods the acetylene method is that most extensively used. It is, or should be, so widely known that no attempt will be made here to set down in detail the technique. It may be summarized as follows.

A mixture of about 20% acetylene with air, purified as suggested by Grollman, is made in a collapsible rubber bag of a capacity of three or four litres, somewhat resembling a football bladder, which is attached by means of a collar to a Douglas bag tap, through the body of which, as close as possible to the mouthpiece, two thin copper tubes are welded. These serve to draw off the respired gases, and evacuated samplers are attached to the distal ends of the tubes. The subject, who must be physiologically basal and psychically tranquil, now inserts the mouthpiece, a nose clip is applied, and for a short time (two minutes) he breathes undisturbed through the side arm of the tap to the air. On the giving of some previously arranged signal the subject breathes out deeply and the tap is then turned to connect him with the mixture in the rebreathing bag, which he must now respire deeply at a fairly fast rate, varying between 25 and 30 respirations per minute, in order quickly and completely to mix the gas in the lungs with that in the bag. It is imperative that no gas should be left in the bag at the end of any inspiration, for this would prolong the time required to attain complete mixing. At the end of the sixth expiration a specimen of the respired gas is taken into one of the samplers and some five or six seconds later (the subject continuing the rebreathing in the meantime) another sample is taken, and still later, if desired, a third; but in any case the last sample must be taken before the completion of one circulation time from the commencement of the procedure, given by Grollman as being twenty-two or twenty-three seconds. The gas samples are then analysed for their acetylene, oxygen and carbon dioxide contents, corrections being applied for apparent increase in nitrogen percentage, and the figures are finally arranged in a table from which values are derived for substitution in the equation elaborated by Grollman.

It is important that the oxygen percentage in the rebreathing bag should at no time fall below 14% or 15%, for should this occur, as can be seen from the oxygen dissociation curve, the oxygen saturation of the blood would be seriously altered and the uptake diminished. Should this occur, it is necessary to repeat the experiment with a gas mixture to which an appropriate amount of pure oxygen has been added.

From the figures obtained by analysis the arterio-venous oxygen difference may be calculated thus (Grollman[9]):

$$A.V.D. = \frac{O_2 \text{ diff.} \times C_2H_2 \text{ av.} \times B. - 48{\cdot}1 \times 0{\cdot}00974}{C_2H_2 \text{ diff.}}$$

where A.V.D. is the arterio-venous oxygen difference, O_2 diff. is the oxygen difference in volumes *per centum* between two samples, C_2H_2 av. is the average concentration of C_2H_2 during the time of taking of two samples, C_2H_2 diff. is the acetylene difference in volumes *per centum* between two samples, B. is the barometric pressure, and 0·00974 is a constant, including the solubility coefficient of acetylene in blood. The arterio-venous oxygen difference

so obtained and the figure for oxygen consumption are substituted in Fick's equation to obtain the cardiac output in litres per minute.

There are certain derived values which are of interest to the clinician, for example, the stroke or systolic output, which is the volume of blood pumped out by the ventricle per beat, can be computed thus: $S.O. = \frac{C.O.}{P.R.}$, where S.O. is the systolic output, C.O. is the cardiac output, and P.R. is the pulse rate.

The cardiac index, which is the volume of blood pumped out by the ventricle per minute per square metre of body surface, can be estimated thus: $C.I. = \frac{C.O.}{S.A.}$, where C.O. is the cardiac output and S.A. is the surface area of the subject in square metres.

The cardiac index, in normal subjects, who are in a basal state and are undisturbed psychically, is a constant having a value of about 2·2 litres per square metre per minute.

In an ideal experiment the value for arterio-venous difference obtained from the first and second samples should agree with that obtained from the second and third samples, or even the first and third, since any pair of samples can be used for substitution in the equation.

It is unfortunately true, even in the case of subjects trained in the procedure and accustomed to the somewhat unpleasant taste and anæsthetic effect of acetylene, that one does not always obtain this ideal agreement between the results computed from the analyses of such pairs of samples, and the disparity may be very great indeed. The practical difficulties of the acetylene method have already been commented upon by Tilmann,[17] McMichael,[16] W. H. Lewis, junior,[12] Dautrebande,[3] Adams and Sandiford,[1] and others, including Baumann and Grollman[6] themselves.

In some instances results have been published without critical comment of investigations in which the acetylene method has been employed, but the results contain within themselves evidence of serious discrepancy. McGuire, Hauenstein and Shore,[13] though realizing the limitations that Grollman had himself placed upon the method, have used it to compute the cardiac output in cases of congestive failure and have employed the direct Fick method coincidentally in these same cases as a check. They conclude, amongst other things, that "as shown in the protocols and table a close qualitative comparison between the acetylene and the direct method was demonstrated". Six cases were demonstrated and a section of the table is adapted and reproduced here (Table I).

The last column on the right does not appear in their paper, but the figures in it have been computed from the two preceding columns. If the direct method is taken as the standard, as indeed it must if the proper precautions are taken to avoid psychic disturbance and consequent elevation of the cardiac output, it will be seen that in only two cases is there reasonable agreement between the two methods, while in the other four cases great disparity is shown; in one of these four the cardiac output estimated by Grollman's method is only 63% of that obtained by the direct method. It will be conceded that these patients were by no means ideal subjects for investigation by the acetylene method or even by the direct method, for though nothing untoward occurred during these experiments, the authors "have decided to make no further studies necessitating direct determinations by the Fick method".

Difficulty has also been experienced in obtaining satisfactory results by the acetylene method, even in the case of healthy, cooperative subjects. Thus McMichael[16] mentions that in tests on normal subjects, presumably medical students, "nearly half of these estimations had to be discarded owing to pronounced discrepancies in the check determinations", and even then those results that he considered acceptable could show up to 7% variation between the values obtained from the first and second samples and the second and third samples.

W. H. Lewis, junior,[12] who has investigated the cardiac output of 100 apparently healthy men aged from forty to one hundred and one years, considered those tests satisfactory "in which the difference in result from samples A and B and that from B and C were less than twelve per cent of the average of A and C".

Adams and Sandiford[1] criticize the three-sample technique and point out that in 76 experiments in their laboratory values obtained from the second pair of samples averaged 12% higher than those from the first samples, and they aver that in these circumstances it is not justifiable to accept even the first value as correct. Gladstone,[7] too, has had some difficulty with the method, and was "gradually and unwillingly forced to the conclusion that the results of the Marshall-Grollman method are heavily weighted with errors which compensate each other to a varying degree under different conditions, rendering the absolute figures obtained sometimes correct, but never completely reliable, and rendering the method insensitive to the detection of small differences, because the size of the errors involved may vary even more than the function to be measured".

Tilmann,[17] as far back as 1933, criticized Lindhard's statement that it was possible by Grollman's method to determine the cardiac output with as much accuracy as is attainable in an erythrocyte count, and stated that he had experienced great difficulty in obtaining concordant results when first he tried the method.

Experiences with the Acetylene Method.

In the laboratories of this department the acetylene method has been tried with somewhat unsatisfactory results. At first the method was restricted to the two-tonometer modification so as not unduly to prolong the rebreathing time, thereby avoiding extension of the experimental time beyond the twenty-two seconds specified by Grollman,[6] and it was applied to the same subject, who was in the basal state, at the same hour on a number of successive mornings. The values for arterio-venous oxygen difference were at first fairly concordant, but occasionally a value was obtained which showed gross disparity when compared with other results, despite the most rigorous control (by stop-watch) of the times of sampling. The three-tonometer modification was then applied to another subject (M.J.M.) over a period of some months, but again the results were unsatisfactory, for, though for periods the arterio-venous oxygen difference as computed from the second pair of samples was close to (but usually, though not invariably, higher than) the value obtained from the first pair of samples, not infrequently values were obtained which not only showed

TABLE I.

Case Number.	Ætiology of Heart Disease.	Cardiac Output, Direct Method. (Fick.)	Cardiac Output, Three Sample Acetylene Method. (Grollman.)	Grollman Fick Results. (Percentage.)
I	Rheumatic heart disease	1·79	1·31	73
II	Subacute bacterial endocarditis, rheumatic heart disease	2·45	1·91	80
III	Arteriosclerosis hypertensive heart disease	2·27	1·69	74
IV	Hypertension	2·04	2·06	101
V	Syphilitic heart disease	1·56	1·65	106
VI	Tuberculous pericarditis, dilatation hypertrophy	2·04	1·28	63

no agreement, but were absurd, ranging from 35 cubic centimetres to 140 cubic centimetres per litre. With other subjects similar disconcerting results were at times obtained, so that finally scepticism developed concerning the correctness of those results which were apparently concordant, the opinion gradually forming that this concordance was perhaps only fortuitous.

Assumptions and Difficulties Underlying the Acetylene Method.

It may be apposite at this point to summarize the assumptions and difficulties underlying the acetylene method.

1. The acetylene must be pure and free from other hydrocarbons or adulterant from the purifying system, for if it were impure in any way this would affect not only its solubility coefficient, but also the accuracy of its analysis.

2. The solubility coefficient must be of a convenient order, neither too large nor too small. Acetylene fulfils this requirement.

3. The acetylene must be non-lipoid soluble. This point has been proved by Baumann and Grollman.

4. The solubility coefficient must remain constant for the blood of different subjects. (This has recently been reinvestigated and confirmed by Priestley and Schwarz.[12]) It must have a high diffusibility in order quickly to produce equilibrium between the blood and the gas in the alveoli.

5. Its analysis must be accurate. This is by no means easily achieved because of its rather high solubility in most reagents used for the absorption of carbon dioxide, which, of course, is found in the lung-bag system. Grollman[13] suggests that during analysis the gases be pumped into the carbon dioxide absorbent for a specified number of times only, and not until an end point is reached. In this manner it was hoped that the amount of acetylene lost by physical absorption would be a constant in any series of analyses, but this constancy can be achieved only very approximately. Recourse was had in this laboratory to the explosion chamber of the Van Slyke and of the Haldane apparatus, but though the explosion of this highly combustible gas can be easily and safely carried out under reduced pressure, yet the analytical results were not satisfactory, and a greyish-white deposit accumulated on the surface of the mercury. It seems that acetylene either polymerizes or combines with mercury, for when some samples of acetylene were shaken in the chamber of the Van Slyke apparatus in the presence of mercury, the temperature remaining constant, a slight though steady drop in the manometric pressure was observed. This fact has also been commented upon by Tilmann, and he gives a table showing that after an aero-tonometer has stood for twenty-four hours the acetylene content invariably becomes less and the carbon dioxide content more than was the case on the previous day. He advances no reason in explanation of the phenomenon, beyond inferring that it is due to some change due to the instability caused by the triple bond in $HC \equiv CH$. It is a well-known fact also that the mercury in the Grollman apparatus grows "dirtier" at a quicker rate than that in the ordinary Haldane apparatus. Since the combustion of acetylene did not yield satisfactory results, analysis was tried in the Van Slyke apparatus along the lines suggested by McMichael,[14] in which only small quantities of KOH solution are used to absorb the carbon dioxide, the amount of acetylene lost by physical absorption thus being reduced to a minimum. However, this only lessens and does not prevent the error introduced by this factor, so various other reagents were tried for the absorption of carbon dioxide in the presence of acetylene, the best being commercial waterglass (Na_2SiO_3), which in solution is hydrolysed thus: $Na_2SiO_3 + H_2O \rightleftarrows SiO_2 + 2NaOH$. It seemed that not even the carbon dioxide was physically soluble in this mixture, but that the reaction $CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$ was entirely a molecular one, occurring only at the surface of the reagent, and consequently somewhat slow, which necessitated its abandonment in favour of saturated caustic potash solution. This too was somewhat slow because of its viscosity, and a newer type of absorber was devised (Figure I), which ensured that there was always an adequate stirring motion within the body of the absorbent so that no "layering" occurred. In these circumstances the carbon dioxide was removed completely and quickly, the acetylene content of the gas undergoing analysis being in no way diminished by loss through physical solubility in the reagent, a finding which was confirmed by check analysis on the same sample. Tilmann[17] had used a similar absorbent, and Gladstone[8] has modified the one suggested by Grollman. The analysis of the acetylene by absorption in the alkaline mercuric cyanide is fairly straightforward, provided the reagent is renewed frequently, and the oxygen of course presents no difficulty. It should be explicitly understood that it is necessary to prepare a correction graph for each Grollman burette used, as the graduation marks often bear a very imperfect relationship to the correct volume. That extreme accuracy is required in the whole analytical technique is brought out clearly by McMichael,[14] who states that "in the example given in Grollman's boook (p. 66) an error of ± 5 in the second decimal place of the acetylene percentages, and therefore the third decimal place of the readings on an 11 c.c. burette would produce an error of plus or minus 11 per cent in the arterio-venous oxygen difference. In calculations with lower percentages of acetylene a similar error in the percentage of acetylene leads to a much higher error in the final result."



FIGURE I.

New type of gas absorber designed to ensure mixing in absorbent and the presentation of a fresh surface to each incursion of gas. Valve at "V".

6. The subject must be physiologically basal and psychically tranquil, points which have been stressed by Grollman[13] and others, for if this is not so the cardiac output will be elevated above normal. In order that this state may be achieved, the subject must be accustomed to the procedure over a period and actively trained in it, so as to remove any anxiety on his part, and furthermore, he must also show ready and active cooperation. These requirements remove beyond the scope of the method a large number of subjects, including those moderately ill, for should the method be applied to these the results are often abortive. Certain pulmonary lesions, such as emphysema and phthisis, collapse, bronchitis, pneumonia, pneumonokoniosis contraindicate its use absolutely, because such conditions interfere seriously with the rate of diffusion of acetylene through the alveolar epithelium, so that the concentration of gas in the alveoli may bear an imperfect relationship to that in the blood.

7. The subject should also have a cardiac output not exceeding ten litres per minute (Baumann and Grollman[2]), for otherwise the circulation time is so short that it is impossible to complete the procedure before recirculation has taken place. For the same reason the method cannot be applied in cases of patent *foramen ovale* or of arteriovenous fistula. The operator should deal tactfully with the subject, and must be manually dexterous and himself experienced in the subjective and objective phases of the technique.

8. All sections of the apparatus must be scrupulously clean. The lung rebreathing bag system must be completely air-tight, for during the forced respirations necessary in the method leaks may occur at the nose or mouth which would cause the samples to yield factitious results. As has been shown, a slight apparent error may cause great variation in the final result. The volume in the lung rebreathing bag system must not be too small, for then the dead space increase in relation to the total volume, according to Adams and Sandiford,[13] produces errors simulating those due to recirculation. Similarly a volume must not be chosen which is beyond the capacity of the subject to breathe in at one inspiration, for this would delay the time required for the attainment of complete mixing.

9. Before the first sample is taken, complete gaseous homogeneity must be achieved in the lung rebreathing bag system, for otherwise the samples taken would be "patchy" and bear an unknown relationship to the gaseous environment in the lung. According to Grollman[10] and Grollman and Marshall,[16] it requires six complete respirations in fifteen seconds to achieve this; but some authors, particularly Gladstone,[17] Hamilton, Spradlin and Saam,[18] contend that in such a period of fifteen seconds, though complete homogeneity may be achieved, such recirculation of blood has already occurred as seriously to interfere with the further uptake of acetylene from the lung alveoli.

Lack of complete mixing in the lung rebreathing bag system almost always manifests itself in the presence of a higher concentration of acetylene in the bag than in the lung alveoli, and it can be shown that substitution of such invalid figures in Grollman's equation yields an arterio-venous oxygen difference lower than the correct figure. Thus:

$$\text{A.V.D.} = \frac{\text{O}_2 \text{ diff.} \times \text{C}_2\text{H}_2 \text{ av.} \times (\text{B.} - 49{\cdot}1) \times 0{\cdot}00974}{\text{C}_2\text{H}_2 \text{ diff.}}$$

Since, if the oxygen concentration is maintained above 15% the oxygen absorption remains practically constant over any given period of time, the equation may be rewritten thus:

$$\text{A.V.D.} = \frac{\text{C}_2\text{H}_2 \text{ av.}}{\text{C}_2\text{H}_2 \text{ diff.}} \times \text{K (constant).}$$

Expanded, that is:

$$\frac{\frac{(\text{C}_2\text{H}_2\ (\text{i})) + (\text{C}_2\text{H}_2\ (\text{ii}))}{2}}{(\text{C}_2\text{H}_2\ (\text{i})) - (\text{C}_2\text{H}_2\ (\text{ii}))} \times \text{K}$$

where (i) and (ii) refer to the number of samples taken. Firstly, suppose that equilibrium had been attained in the lung-bag system and that the true value for C_2H_2 (i) was 10% and that for C_2H_2 (ii) was 5%. If the substitution is made,

$$\text{A.V.D.} = \frac{\frac{10+5}{2}}{10-5} \times \text{K} = \frac{7{\cdot}5}{5} \times \text{K} = 1{\cdot}5\ \text{K}$$

Suppose now that, owing to incomplete mixing, the acetylene in the bag is for sample (i) 2% higher than it is in the alveoli, then the apparent arterio-venous difference is:

$$\text{A.V.D.} = \frac{\frac{(10+2)+5}{2}}{(10+2)-5} \times \text{K}$$

That is,

$$\text{A.V.D.} = \frac{\frac{17}{2}}{12-5} = \frac{8{\cdot}5}{7}\ \text{K} = 1{\cdot}2\ \text{K}$$

Thus in the second case, in which gaseous homogeneity has not been achieved, the arterio-venous oxygen difference is $\frac{1{\cdot}2}{1{\cdot}5} \times \frac{100}{1}$, that is, 80% of the former value.

Gladstone has shown that in the rapid deep respirations required by the Grollman technique appreciable recirculation may take place even by the tenth second, and he has devised an ingenious system by means of which he aims to attain complete mixing by the end of the fourth second; but it is doubtful whether this modification can be applied to most subjects.

Adams and Sandiford[13] confirm the findings of Gladstone that recirculation may occur before the end of the fifteenth second, and they have devised a modification which they term an internal check, by means of which they aim to determine whether any such recirculation has taken place, and if this has happened the results are rejected and the experiment is repeated. Yet, despite these precautions, only 46% of their 82 investigations gave an error of less than ± 5%.

If, as Gladstone points out, in some cases appreciable recirculation occurs before the fifteenth second—that is, before the first sample is taken—this phenomenon must be met with more frequently in relation to the second and third samples.

These two prerequisites of the technique—namely, that there should be complete homogeneity in the lung rebreathing bag system, which cannot easily be attained in less than five respirations, and that there should be little if any recirculation during the whole course of the experiment—are mutually antagonistic, for the forced breathing required for the quick attainment of complete mixing must necessarily increase the rate of circulation and so shorten the time taken for the already acetylene-laden blood to return to the lungs. This blood, being already partly saturated, cannot dissolve its full quota of acetylene, and the apparent acetylene difference as computed from analysis of the rebreathing air is much less than it should be.

Such a figure, when substituted in Grollman's equation, will give a value for the arterio-venous oxygen difference somewhat higher than the real one, and as the recirculation continues the apparent acetylene difference will diverge more and more from what it ought to be, and when substituted in the equation will give higher and higher values for the arterio-venous difference. As can be seen, by *reductio ad absurdum*, if there has been such gross recirculation that there is a state of complete equilibrium between the alveolar acetylene and the whole of the blood, no acetylene at all would be dissolved, the acetylene difference would be nil and the computed arterio-venous oxygen difference would be infinity!

This increase of the arterio-venous oxygen difference with successive samples is one that has been noted by most observers, and supplies additional evidence of the frequent occurrence of some recirculation during the short time allotted to the experiment. This must not be confused with the coronary recirculation, which in any case is small (according to Tilmann[17] not more than 5% of the total); but in any case Grollman's method measures the cardiac output less that of the coronary circulation. Gladstone and Dack[19] have also pointed out that during the first portion of the rebreathing period excessive amounts of carbon dioxide are given off, compared with the oxygen taken up, and as the carbon dioxide mounts up it tends to depress the amount of oxygen taken up by the blood in accordance with the oxyhæmoglobin dissociation curve. This of course will reflect itself in the arterio-venous oxygen difference as calculated from Grollman's equation; but this error is not likely to reach the magnitude of that caused by recirculation.

Thus the difficulties involved in the avoidance of imperfect mixing and recirculation are not easy to overcome in practice, and an absurd and impossible result is often the first and only indication that the experiment is abortive.

It should also be mentioned that there is some uncertainty among the authors as to whether the samples should or should not be alveolar; Grollman[10] merely states that "it is advisable to take them at the end of expiration". In any case it is impossible to obtain alveolar samples from the lung rebreathing bag system commonly used in the acetylene method, though the strict application of the theory of the method seems to require such samples.

There is never complete homogeneity between the gaseous contents of the bag and that of the lungs, for acetylene is being continually removed from the alveoli by the blood, and this gas on expiration is mixed with an indefinite but appreciable volume of gas richer in acetylene from the pulmonary and instrumental dead space; the condition of incomplete mixing described earlier is thus produced only in minor degree. Therefore it seems that alveolar sampling is another necessary prerequisite for the efficient application of the method; but this cannot be realized, or can be realized only imperfectly, from the usual arrangement of the rebreathing bag.

It is quite possible in the one experiment to have appreciable recirculation and at the same time incomplete mixing in the lung rebreathing bag system. In these circumstances a result would be obtained in which the "low" arterio-venous difference due to lack of homogeneity would be offset to a variable extent by the "high" arterio-venous difference caused by recirculation, and such a result might well be within the anticipated range; but it would nevertheless be fortuitous and fictitious.

A method easier to apply was sought, and a modification and elaboration of the carbon dioxide method were attempted. These will be set out in detail in a subsequent paper.

Summary.

A review has been made of the technical difficulties met with in the application of the acetylene method for the determination of the cardiac output.

The two principal difficulties are the non-attainment of gaseous homogeneity in the lung rebreathing bag system by the time the first gas sample is taken, and the recirculation, by short paths, of an appreciable quantity of blood already partly saturated with acetylene. It is suggested that the time allowed by Grollman, twenty-two seconds, is too long, since in some subjects at least considerable recirculation has taken place by the end of that time.

Lack of homogeneity in the lung rebreathing bag system manifests itself in a fictitiously low arterio-venous difference as calculated from Grollman's equation, whereas recirculation causes this value to be fictitiously high. It is possible for both of these factors to operate during the same rebreathing experiment.

Another problem, though perhaps a minor one, is the loss of acetylene content which a gas sample undergoes when it stands in contact with mercury for any length of time.

Improvements are suggested in analytical technique for acetylene-expired air mixtures.

Acknowledgements.

I wish to acknowledge my indebtedness to Dr. Adolph Bolliger for assistance in the translation of some of the articles consulted and mentioned in the references. My thanks are also due to Professor Lambie, under whose supervision and direction the work was done, for his help and criticism.

References.

(1) W. Adams and I. Sandiford: "The Measurement of the Cardiac Output: An Improvement of the Acetylene Method Providing an Inherent Check", *The Journal of Clinical Investigation*, Volume XX, 1941, page 87.

(2) H. Baumann and A. Grollman: *"Über die theoretischen und praktischen Grundlagen und die klinische Zuverlässigkeit der Acetylenmethode zur Bestimmung des Minutenvolumens"*, *Zeitschrift für klinische Medizin*, Volume CXV, 1930, page 41.

(3) L. Dautrebande: *"Influence des inhalations prolongées et répétées d'anhydride carbonique sur la circulation, la composition du sang et la diurèse"*, *La Médecine*, March, 1938, 1938, page 194.

(4) A. Fick: *"Ueber die Messung des Blutquantums in den Herzventrikeln"*, *Sitzungsberichte der physikalische-medicinische Gesellschaft zu Würtzburg*, 1870, page 16; quoted by Burwell and Robinson, *The Journal of Clinical Investigation*, Volume I, 1924, page 90.

(5) S. A. Gladstone: "A Modified Foreign Gas Method for Determination of Cardiac Output in Man", *Proceedings of the Society of Experimental Biology and Medicine*, Volume XXXII, 1934, page 1321.

(6) S. A. Gladstone and S. Dack: "Respiratory Exchange of Oxygen and Carbon Dioxide during Rebreathing in a Rubber Bag", *Proceedings of the Society of Experimental Biology and Medicine*, Volume XXXII, 1934, page 1315.

(7) S. A. Gladstone: "The Factor of Recirculation in the Acetylene Method for Determination of Cardiac Output", *Proceedings of the Society of Experimental Biology and Medicine*, Volume XXXII, 1934, page 1319.

(8) A. Grollman: "The Cardiac Output of Man in Health and Disease", 1932.

(9) A. Grollman and E. K. Marshall: "The Time Necessary for Rebreathing in a Lung-Bag System to Attain Homogeneous Mixture", *The American Journal of Physiology*, Volume LXXXVI, 1928, page 110.

(10) W. F. Hamilton, M. C. Spradlin and H. G. Saam, junior: "An Inquiry into the Basis of the Acetylene Method of Determining the Cardiac Output", *The American Journal of Physiology*, Volume C, 1932, page 587.

(11) S. Lauter: *"Kreislaufprobleme"*, *Münchener medizinische Wochenschrift*, Volume LXXVII, 1930, page 526; cited by Grollman, *loco citato*.

(12) W. H. Lewis, junior: "Changes with Age in the Cardiac Output in Adult Men", *The American Journal of Physiology*, Volume CXXI, 1938, page 517.

(13) J. McGuire, V. Hauenstein and R. Shore: "Cardiac Output in Heart Disease", *Archives of Internal Medicine*, Volume LX, 1937, page 1034.

(14) J. McMichael: "Postural Changes in Cardiac Output and Respiration", *Quarterly Journal of Experimental Physiology*, Volume XXVII, 1937, page 55.

(15) J. C. Meakins and H. W. Davies: "Observations on the Gases in Human Arterial and Venous Blood", *The Journal of Pathology and Bacteriology*, Volume XXIII, 1920, page 451.

(16) J. G. Priestley and H. Schwarz: "The Solubility of Acetylene in Blood. I. The Determination of Acetylene Dissolved in Blood and other Liquids", *The Journal of Physiology*, Volume XCIX, 1940, page 49.

(17) O. Tilmann: *"Die Brauchbarkeit und der Anwendungsbereich der Grollmanschen Acetylenmethode zur Herzminutenvolumenbestimmung"*, *Zeitschrift für die gesamte experimentelle Medizin*, Volume XC, 1933, page 625.

ANTILEUCOCYTIC SHEEP SERUM AS SENSITIZING AGENT IN CHRONIC MYELOID LEUCHÆMIA REFRACTORY TO DEEP X-RAY THERAPY.

By J. B. THIERSCH.

From the Institute of Medical and Veterinary Science, Adelaide, South Australia.

THE treatment of chronic leuchæmia with X rays is regarded as only palliative. It renders the patient more comfortable for a period after the irradiation, without curing the disease or prolonging the life of the patient. The effect on the white blood cell count is most pronounced after approximately three weeks. Usually patients respond to a few treatments with decrease in the size of the spleen, rise in hæmoglobin value and improvement in general health; thereafter the effect of the irradiation becomes less noticeable, and finally the condition becomes refractory even to large doses of X rays. The experience with deep X rays in acute leuchæmia is very discouraging and benefit rarely accrues.

An attempt was made to "sensitize" patients suffering from chronic myeloid leuchæmia refractory to deep X rays. For this purpose an antileucocytic sheep serum was prepared and injected; this had the effect desired. It must be stressed that the use of serum is also only a palliative measure, neither curing the patient's illness nor prolonging his life.

Lindström[1] first used antileucocytic serum in the treatment of leuchæmia. He reported great reduction of the number of leucocytes after injection of antiserum, and also demonstrated in animal experiments that when it was injected intravenously his serum reduced the number of circulating leucocytes.

Hueper and Russell[2] tried a similar serum in a case of leuchæmia, and Piazza[3] examined the effects of an antiserum against leucocytes *in vitro*. All these workers emphasize the specific action of the antiserum on the white blood cells, but more data regarding previous treatment of the leuchæmic patients, particularly of their irradiation prior to the treatment with serum, would be useful. In veterinary medicine cows are reported to have been treated with antiserum prepared from healthy animals by repeated injections of excised lymph nodules from cows suffering from leuchæmia.[4]

Preparation of Antileucocytic Serum.

Over a period of two and a half months, two sheep were injected repeatedly with human leucocytes taken from leuchæmic patients with a high white blood cell count. Venous blood was taken from the patients and citrated saline solution was added as an anticoagulant; the blood was then placed in long glass tubes and left standing for twelve hours at 4° C. The layers of white cells were then carefully separated from the red cells, diluted with saline solution, and injected into sheep.

Six subcutaneous injections and two intravenous injections of increasing numbers of white cells, containing numerous immature forms, were given first at intervals of one week and later of a fortnight. Two weeks after the last intravenous injection the sheep were bled. The serum was separated and filtered through an "HK Seitz" filter, and 0·5% phenol solution was added. (An attempt at culture produced no growth of organisms.) Subsequently antiserum was prepared on the same lines in monkeys, which had to be destroyed because of tuberculosis, and in two more sheep, which developed hæmolysins for human red cells and whose serum was therefore discarded. The serum from the first two sheep was then kept in a closed glass bottle at 4° C. until it was used. Before use the serum was tested against human blood. The sheep antiserum agglutinated and hæmolysed human red cells in a dilution of 1 in 64. No definite limitation of its agglutinating power for white blood cells could be established by diluting the serum with saline solution and testing it against normal leucocytes, because they showed pronounced iso-agglutination and the readings were therefore inaccurate.

Antileucocytic Serum Applied to Leuchæmic Patients.

Normal sheep serum injected into two patients suffering from chronic myeloid leuchæmia had no effect on the temperature, pulse rate, white blood cell count, size of spleen *et cetera*.

Each of three patients was given 0·1 cubic centimetre of the antileucocytic serum intradermally, then 1·0 cubic centimetre or more subcutaneously; as no anaphylactic reactions were observed, 10 to 120 cubic centimetres were injected very slowly by the intravenous route. During the intravenous injection the patients showed flushing of their faces, a rise in pulse rate and a desire to vomit. This condition lasted for about ten minutes. After that they felt well and walked about. After six to eight hours, however, a rise in temperature to 104° F. occurred, with profuse sweating and acceleration of the pulse rate; these symptoms subsided after approximately one hour. The patients felt well afterwards and showed no further signs of ill effects of the serum.

TABLE I.

Preparation of the Sheep Antiserum. Data of Injections of Isolated Human Leuchæmic White Blood Cells into Two Sheep. The Blood was Collected from Four Patients with Chronic Myeloid Leuchæmia.

Number of Injection.	Day of Injection.	Number of Cubic Centimetres of Leuchæmic Blood Used for Isolation of White Blood Cells.	Number of Total White Blood Cells per Cubic Millimetre.	Percentage of Immature Forms.
1	1	20	64,000	20
2	8	20	100,000	35
3	15	25	145,000	60
4	22	28	160,000	65
5	29	40	200,000	65
6	36	50	212,000	70
7	50	35	200,000	70
8	64	60	300,000	90
	90	Sheep bled or preparation of serum.		

TABLE II.

Day of Illness.	Deep X-ray Treatment of Spleen; Dosage in r.	Level of Spleen. Response.	Hæmoglobin Content in 100 Cubic Centimetres of Blood.	Red Blood Cells. (Millions.)	White Blood Cells. (Thousands.)	Polymorpho-nuclear Cells.	Myelocytes.	Myeloblasts.	Nucleated Red Cells.
1	180	Below umbilicus.	11·232	4·27	85·0	—	—	—	—
20	—	Halfway between costal margin and umbilicus.	—	—	—	—	—	—	Present.
155	330	Below umbilicus.	—	—	—	—	—	—	Present.
175	—	Five centimetres below costal margin.	12·79	—	12·5	82	8	—	Present.
464	360	Umbilicus.	12·79	—	75·0	60	40	—	Present.
564	—	Five centimetres below umbilicus.	14·79	—	15·0	90	10	—	Present.
881	660	Umbilicus.	12·48	4·5	141·0	32	63	2	2%
923	—	Ten centimetres below costal margin.	15·13	5·75	7·5	91	5	—	Present.
1,016[1]	—	Spleen slowly increasing in size.	10·92	3·5	139·0	59	26	2	Present.
1,017	—	Spleen slowly increasing in size.	10·76	—	127·0	61	33	2	Present.
1,018[2]	—	Spleen slowly increasing in size.	10·92	—	149·0	62	22	4	Present.
1,019	—	Spleen slowly increasing in size.	11·07	—	127·0	54	42	4	Present.
1,021[3]	—	Spleen slowly increasing in size.	10·76	—	108·0	44	51	4	Present.
1,038	—	Spleen slowly increasing in size.	11·32	—	150·0	36	59	2	Present.
1,056	—	Spleen slowly increasing in size.	10·14	—	167·0	50	42	8	Present.
1,063	220	Umbilicus.	10·29	—	176·0	18	80	2	Present.
1,148	—	Just palpable below costal margin.	14·04	4·5	4·25	80	2	—	Present.
1,284	220	Seven centimetres below costal margin.	13·39	5·17	1·08	35	62	1	1%
1,343	—	Costal margin.	17·16	5·3	8·5	87	3	2	Present.
1,485	200	Ten centimetres below costal margin.	13·1	5·29	131·0	49	45	3	1%
1,537	—	Five centimetres below costal margin.	14·04	—	12·0	84	16	—	—
1,570	140	Umbilicus.	9·51	—	140·0	14	32	21	—
1,597[4]	—	Below umbilicus.	6·24	—	460·0	8	4	64	4%

[1] Anti-leucocytic sheep serum given intravenously (17 cubic centimetres).
[2] Anti-leucocytic sheep serum given intravenously (110 cubic centimetres).
[3] Strong anaphylaxis against normal sheep serum.
[4] Day of death.

Reports of Cases.

CASE I.—O.D., a male patient, aged forty-three years, was under medical care for chronic myeloid leuchæmia for thirty-three months (Table II). Previously the patient had had four courses of deep X-ray therapy over the enlarged spleen and the ribs, but did not respond well to the last course of irradiation; his spleen did not greatly decrease in size. At the time of injection of antiserum the patient had a general enlargement of lymph nodules in the groin, axilla and neck. The spleen was enlarged and reached almost to the umbilicus.

The patient was given 17 cubic centimetres of antileucocytic sheep serum intravenously after no reaction to an intradermal and subcutaneous injection of 1·0 cubic centimetre was noticed. Seven hours later the temperature rose to 104° F. and profuse sweating and acceleration of the heart rate set in. These effects subsided after an hour and the patient returned to his previous state of health. Two days after the first injection the patient was given 110 cubic centimetres of antileucocytic sheep serum, and the same reaction occurred six hours afterwards. The patient was kept under close observation and was found after a fortnight to be very sensitive towards normal sheep serum. His spleen enlarged gradually after the serum injection, reaching to the umbilicus in forty days. A course of deep X rays—220 *r*, a much smaller dose than he had had prior to the serum injection—reduced his spleen to the costal margin and improved his hæmoglobin value and general health. Later the spleen enlarged again and three further courses of deep X rays were applied with good effect. The patient died from an acute hæmorrhage 580 days after the serum injections.

In this case it was noticed that the patient's spleen, which had been refractory to deep X-ray therapy with doses of 660 *r*, became sensitive to 220 *r* after the injection of serum.

TABLE III.

Day of Disease under Medical Care.	Deep X-ray Treatment; Dosage in *r*.	Response of Spleen to Treatment.	Hæmoglobin in Grammes per 100 Cubic Centimetres of Blood.	Red Blood Cells. (Millions.)	White Blood Cells. (Thousands.)	Polymorphonuclear Cells.	Myelocytes.	Myeloblasts.	Nucleated Red Cells.
1	640	Below umbilicus.	8·42	3·89	310·0	—	—	—	Present.
45	—	Impalpable.	—	—	—	—	—	—	—
105	640	Increasing number of leucocytes.	15·13	5·26	60·0	—	—	—	Present.
160	—	Impalpable.	13·41	5·0	30·0	—	—	—	Present.
190	640	Impalpable.	12·48	—	104·0	55	40	5	Present.
222	—	Impalpable.	15·13	4·78	26·0	—		—	Present.
256	480	Impalpable.	11·38	4·0	56·0	—	—	—	Present.
313	—	Five centimetres below costal margin.	13·26	5·0	42·0	—	—	—	Present.
346	250	Seven centimetres below costal margin.	13·26	—	38·0	—	—	—	Present.
434	—	Five centimetres below costal margin.	10·92	3·9	96·0	24	74	2	Present.
463	380 (over chest)	Enlarging further.	9·36	3·85	165·0	14	72	14	Present.
488	—	Below umbilicus.	9·98	4·63	142·0	68	22	10	Present.
563	350 (spleen)	Below umbilicus.	9·36	—	229·0	35	53	10	Present.
580	—	One centimetre to left of umbilicus.	13·26	4·5	18·0	73	17	4	Present.
632	—	Spleen tender and slowly enlarging.	12·98	4·98	115·0	43	51	5	Present.
636[1]	—	Spleen tender and slowly enlarging.	11·38	—	124·0	22	60	18	Present.
638	—	Spleen tender and slowly enlarging.	12·04	—	104·0	31	53	3	Present.
641[2]	—	Spleen tender and slowly enlarging.	12·94	—	134·0	55	38	6	Present.
642	—	Spleen tender and slowly enlarging.	12·20	—	149·0	42	46	8	Present.
657	—	Spleen tender and slowly enlarging.	12·16	3·19	166·0	38	53	9	Present.
674	220	One centimetre to right of umbilicus.	11·85	4·01	250·0	45	46	6	Present.
714	—	Midway between umbilicus and symphysis.	9·3	4·5	64·0	51	41	7	Present.
775	220	Halfway between umbilicus and right *os ilium*.	11·7	—	152·0	45	43	10	2%
838	—	Seven centimetres below umbilicus.	12·01	4·75	116·0	51	41	7	1%
867	330	Five centimetres to left of right *os ilium*.	8·63	—	115·0	38	24	27	10%
930	—	Seven and a half centimetres below umbilicus.	12·82	5·35	81·0	51	36	12	Present.
957	330	Four centimetres from right *os ilium*.	9·51	3·8	103·0	20	65	15	Present.
980	—	Middle line.	12·48	5·39	7·5	80	14	3	Present.
1,048	330	Five centimetres from right *os ilium*.	9·82	3·38	110·0	23	66	11	Present.
1,072	—	Five centimetres from right *os ilium*.	12·16	4·02	13·5	75	22	1	Present.
1,109	330	Reaches right *spina iliaca anterior*.	8·11	3·82	61·0	22	66	5	5%
1,135	—	Five centimetres below umbilicus.	10·92	5·29	24·0	27	56	13	Present.
1,192	230	Reaches right *spina iliaca antero-superior*.	10·68	3·79	72·0	15	65	20	Present.
1,218	—	At umbilicus.	11·388	4·16	19·0	38	58	5	Present.
1,280	120 (pericardium)	Right *spina iliaca antero-superior*.	9·36	—	234·0	26	45	29	2%
1,284[3]									

[1] Injection of 70 cubic centimetres of anti-leucocytic sheep serum.
[2] Injection of 25 cubic centimetres of anti-leucocytic sheep serum.
[3] Died of hæmorrhage.

CASE II.—A.N., a male patient, aged thirty-six years, had been under medical care for chronic myeloid leuchæmia for twenty-one months (Table III). He had general enlargement of lymph nodules and spleen. He was treated previously with seven courses of deep X rays over spleen and ribs. The response of the patient to the last three courses was unsatisfactory; the size of the spleen did not decrease, nor did the hæmoglobin value improve as was expected. The radiologist regarded the condition as hopeless and resistant to deep X rays. The patient was given 1·0 cubic centimetre of antileucocytic sheep serum subcutaneously and 0·1 cubic centimetre intradermally, with a pronounced reaction after one hour. The next day another 1·0 cubic centimetre of serum was given subcutaneously, and as no reaction was visible 70 cubic centimetres were given intravenously.

During the injection the patient had a throbbing head and an increased pulse rate, and the systolic blood pressure rose from 130 to 180 millimetres of mercury. Immediately afterwards the patient was well and went home. Six hours afterwards profuse sweating with a temperature of 104° F. occurred and lasted for about two hours. After this the patient felt well and went to work. Two days later he received intravenously another 25 cubic centimetres of the antileucocytic sheep serum; the administration was accompanied during the injection and for fifteen minutes afterwards by flushing of the head, sweats and accelerated action of the heart. Seven hours later a high temperature and sweating occurred and subsided after approximately one hour. His spleen increased in size and his white blood cell count rose, but fell under renewed deep X-ray treatment.

The patient responded unexpectedly well to the deep X-ray treatment, with a decrease in the white blood cell count and size of the spleen and improved general health. The patient received another eight courses of deep X rays at intervals of three months, and finally died of an acute hæmorrhage from a bronchus.

According to the clinician and radiologist, a definite alteration in the response of the patient to the irradiation was noticed, and apparently a sensitization took place with and after the serum injection.

CASE III.—R.B., a male patient, aged forty-six years, came into hospital at the onset of an acute myeloblastic leuchæmia (Table IV). He had bleeding from his gums, petechial hæmorrhages all over his body and a high temperature swinging between 102° and 104° F. The lymph nodules in the axillæ, groins and neck were enlarged to the size of pigeon eggs, and the liver and spleen were palpable. The white blood cells numbered 50,000 per cubic millimetre and the hæmoglobin value was 4·9 grammes per 100 cubic centimetres of blood; the film showed a predominance of paramyeloblasts, numerous nucleated red cells and a lack of platelets. As the patient was unfit for irradiation he was

TABLE V.

Technique of Irradiation.

(The filter was constant throughout—one millimetre of copper and one millimetre of aluminium; the kilovoltage was 200.)

Day of Illness.	Open Field Time in Distance Minutes.	Number of Doses.	Total r.
Table II			
1	40 centimetres 12	3× 4 minutes alternate days.	180
155	40 centimetres 16	2× 8 minutes alternate days.	330
464	40 centimetres 24	6× 9 minutes alternate days.	360
881	50 centimetres 30	3×10 minutes alternate days.	660
1,063	50 centimetres 30	3×10 minutes alternate days.	220
1,284	50 centimetres 30	3×10 minutes alternate days.	220
1,485	50 centimetres 24	3× 8 minutes alternate days.	200
1,570	50 centimetres 15	3× 5 minutes alternate days.	140
Table III			
1	40 centimetres 20	4× 5 minutes alternate days.	640
105	40 centimetres 20	4× 5 minutes alternate days.	640
190	40 centimetres 20	4× 5 minutes alternate days.	640
256	40 centimetres 15	3× 5 minutes alternate days.	480
346	50 centimetres 20	4× 5 minutes alternate days.	250
463	50 centimetres 30	2×15 minutes alternate days.	380
563	50 centimetres 15	3× 5 minutes alternate days.	350
674	50 centimetres 20	2×10 minutes alternate days.	220
775	50 centimetres 20	2×10 minutes alternate days.	220
867	50 centimetres 30	3×10 minutes alternate days.	330
957	50 centimetres 30	6× 5 minutes alternate days.	330
1,048	50 centimetres 30	3×10 minutes alternate days.	330
1,109	50 centimetres 30	3×10 minutes alternate days.	330
1,192	50 centimetres 30	6× 5 minutes alternate days.	230
1,280	10×15 field 5	1× 5	120
Table IV			
87	50 centimetres 20	4× 5 minutes alternate days.	400
106	80 centimetres 35	1×10 minutes. 3× 8 minutes.	500

TABLE IV.

Day of Illness.	Treatment with Irradiation, Anti-Leucocytic Serum, Blood Transfusion.	Spleen Response.	Hæmoglobin in Grammes per 100 Cubic Centimetres of Blood.	Red Blood Cells. (Millions.)	White Blood Cells. (Half Millions.)	Polymorphonuclear Cells.	Myelocytes.	Myeloblasts.	Nucleated Red Cells.	Remarks.
1	Admission to hospital.	Palpable.	4·99	1·66	50	32	11	55	2	Glands in axilla and groin palpable. Ulcerated gums. Basal metabolic rate +50%.
2	1,140 cubic centimetres of blood and 150 cubic centimetres of anti-leucocytic sheep serum IV.	Palpable.	3·2	1·11	47	38	12	47	3	Glands enlarging to size of cherries.
3		Palpable.	—	—	32	24	1·5	75	2	
6		Increasing.	7·176	2·05	18	32	2	63	2	Glands of neck enlarging.
13	Blood transfusion (650 cubic centimetres).	At costal margin.	—	—	15	45	5	47	1	Glands of jaw enlarging.
25	Blood transfusion (500 cubic centimetres).	At costal margin.	9·36	3·11	14	42	—	49	3	Glands, spleen, liver stationary.
87	Deep X-ray therapy.	2·5 centimetres below costal margin.	7·8	2·35	112	18	12	51	7	
98	Blood transfusion (400 cubic centimetres).	5·0 centimetres below costal margin.	6·08	2·15	76	31	12	56	1	Basal metabolic rate + 65%.
106	Deep X-ray therapy.	5·0 centimetres below costal margin.	4·53	2·4	176	9	42	47	2	Gradual enlargement of all palpable lymph glands to size of cherries and golf balls. ulcerated gums.
107	Deep X-ray therapy.	7·0 centimetres below costal margin.	4·53	2·44	135	7	—	93	Present.	
109	Blood transfusion (200 cubic centimetres).	10·0 centimetres below costal margin.	5·46	2·59	69	12	—	88	Present.	Petechiæ.
122	Death from hæmorrhage.		5·304	2·66	86	8	16	77	2	

given a blood transfusion (two pints at first) and after that 150 cubic centimetres of antileucocytic sheep serum intravenously. He collapsed, but recovered in a few hours. His temperature came down to 98° F., the white blood cell count decreased and the patient felt much better. He was sent home and came to the hospital for two further transfusions. He lived for four months after administration of the sheep serum and died in another outburst of his acute leuchæmia, uncontrollable with two courses of small doses of deep X rays and blood transfusion.

Clinically, a definite improvement occurred after the injection of sheep antiserum, with a decrease in the number of white blood cells and a fall in temperature, an effect which the other two blood transfusions had not had. Clinically at least the impression was gained that the first acute outburst of his leuchæmia was favourably influenced by the injection of sheep antiserum.

Summary.

1. Two patients suffering from chronic myeloid leuchæmia, refractory to deep X rays, were injected with the serum of sheep that had been repeatedly injected with increasing numbers of leuchæmic cells of the myeloid series. After a strong reaction, appearing six to seven hours after the intravenous injection and consisting of a rise in temperature to 104° F., profuse sweats and acceleration of the heart rate, no ill effect was noticed. Deep X-ray treatment of the patient's spleen forty days after the sheep serum injection revealed a "sensitization" resulting in a pronounced decrease in the size of the organs with an improvement in the general health.

2. A patient suffering from acute myeloblastic leuchæmia was treated with antileucocytic sheep serum, with a temporary remission of the acute attack.

Conclusion.

Antileucocytic sheep serum does not cure leuchæmia or prolong the life of the patient.

References.

(1) G. A. Lindström: *"Expériences sur les animaux de traitement par le sérum leucolytique", Archives des maladies du coeur et des vaisseaux*, Volume XIV, 1921, page 145; "Experimental Study of Myelotoxic-sera. Therapeutic Attempts in Myeloid Leucæmia", *Acta medica Scandinavica*, Supplement XXII, 1927, page 1.

(2) W. C. Hueper and M. Russell: "Some Immunologic Aspects of Leukæmia", *Archives of Internal Medicine*, Volume XLIX, 1932, page 113.

(3) M. Piazza: *"Ricerche sulla leucolisi spontanea e provocata nei leucemici. Tentativi di autoemotrattamento", Policlinico (sezione medica)*, Volume XXXVIII, 1931, page 116.

(4) F. Schoeller: *"Ueber die Aetiologie und Therapie der aleucämischen Lymphadenose des Rindes", Berliner Tierärztliche Wochenschrift*, Volume L, 1934, pages 497 and 513.

Reports of Cases.

GONOCOCCAL MENINGITIS.

By JEAN ARMYTAGE, M.B., B.S.,
Acting Bacteriologist, Royal Prince Alfred Hospital, Sydney.

GONOCOCCAL meningitis is a rare disease. Only some 52 cases have been reported in the literature. However, it is not unlikely that it is more common than is usually supposed. Henderson and Ritchie[1] collected the reports of 27 cases which occurred before 1909, and in 1933 the literature was reviewed and further cases were reported by Bradford and Kelley[2] and by Strumia and Kohlhas.[3] Attention was drawn by the last-mentioned authors to the fact that absolute proof was not brought forward in all instances, but that sometimes diagnoses were made on circumstantial evidence. In 1938 Marvin and Wilkinson[4] and later Branham, Mitchell and Brainin[5] reported cases. The report of Branham and her colleagues, working at the National Institute of Health at Washington, is of particular interest, in that during a special study of meningeal strains of Gram-negative diplococci, 10 (2%) of the 500 cultures received for typing proved to be gonococci and not meningococci.

In the majority of the cases reported a gonococcal infection elsewhere was known to be present, either before or at the time of onset of the meningeal symptoms. In an occasional instance, however, the meningitis arose without any other apparent focus.

Clinical Record.

R.L., a male patient, aged twenty-one years, was admitted to hospital on December 31, 1940, suffering from meningitis. On December 26, while on a camping trip, he developed a backache followed by a headache of increasing intensity and accompanied by vomiting. Abandoning his holiday, he returned home, where he was treated for sunstroke. On the following day he complained that the light hurt his eyes and that he had severe pain in the neck, legs and lumbar region. He became rapidly worse, and on his admission to hospital he was restless and delirious, had pronounced neck rigidity and muscular hypertonus; Kernig's sign was elicited. His pupils reacted sluggishly to light. His temperature was 100° F. and his pulse rate was 108 per minute; respirations numbered 26 per minute. A lumbar puncture was performed and turbid fluid under increased pressure was withdrawn. On examination the fluid was found to contain 1,640 neutrophile cells per cubic centimetre; the chloride content was 640 milligrammes *per centum*, the total protein was 100 milligrammes *per centum*, and the sugar content was 70 milligrammes *per centum*; the globulin content was increased. No organisms were found in the direct smear, but on culture a scanty growth of small, translucent, convex colonies of Gram-negative diplococci was obtained. A diagnosis of meningococcal meningitis was made and sulphapyridine treatment was begun immediately. Four grammes of the drug were given by mouth, followed by two grammes every four hours for three days and then one gramme every four hours for the next six days.

Several other investigations were carried out on the patient's admission to hospital. The leucocytes were found to number 7,500 per cubic millimetre, 61% being neutrophile cells. A naso-pharyngeal swab yielded no meningococci, and an attempt at blood culture resulted in no growth after 144 hours' incubation.

Lumbar puncture on January 3, 1941, showed the cerebro-spinal fluid to be sterile, as were all subsequent specimens. The fluid on this date contained 252 cells per cubic millimetre, and in all later specimens of cerebro-spinal fluid the number of cells was normal. By January 9 the patient appeared well; he had no nervous signs or symptoms, but he still had a temperature of 99° F. The following day epididymitis developed. Although there was no obvious discharge, a direct smear made from material obtained by prostatic massage revealed Gram-negative intracellular and extracellular diplococci morphologically resembling gonococci, and cultures on blood agar produced a moderate growth of translucent colonies of Gram-negative diplococci. By good fortune the culture from the cerebro-spinal fluid was still in the laboratory, and as there was a possibility that the two organisms were identical, fermentation reactions and agglutination tests were attempted with the two strains. The technique employed in the fermentation reactions was that of Dr. N. E. Goldsworthy and Dr. J. L. Still (personal communication), which is as follows.

Technique for Determining Fermentation Reactions of Neisseria.

Ordinary peptone water (1%) was prepared, and to it was added 1% of Andrade's indicator. To this base any desired test substance can be added, generally in a concentration of 1%. In this way glucose-indicator-peptone water, maltose-indicator-peptone water and sucrose-indicator-peptone water were prepared. The media were distributed in test tubes, six inches by three-quarters of an inch in size, in quantities of two millilitres, together with 0·5 millilitres of horse serum previously heated at 65° C. for sixty minutes to inactivate the serum maltase. The completed medium was clear, so that growth could easily be detected in it. Previous experiments had shown that adequate aeration was desirable, hence the small quantity of medium in a large test tube, in order to increase the ratio of surface to volume. Each tube was heavily inoculated from a heated horse-serum-agar culture of the organism to be tested, and cultures were incubated at 37° C. for three to five days. Generally the result is clear on the third day. Approximately 25 strains of known origin (either cerebro-spinal fluid or the male urethra), as well as stock strains used for experimental work, were tested by this method and found to give satisfactory results.

Results.

The two strains (meningeal and urethral) from the patient gave clear-cut results. Both fermented glucose only and the controls (known strains of gonococci and meningococci) gave their characteristic sugar reactions. Serological identification could not be carried out, since although the organisms gave a smooth suspension in saline solution, neither could be suspended in 1/10 horse serum.

The following week the patient was discharged to the venereal out-patient department.

Comment.

The identification of *Neisseria gonorrhœæ* is not an easy task. It appears that the fermentation reactions, though difficult, give the most reliable indication if properly carried out.

Serological identification is not conclusive, as the gonococci are well agglutinated by polyvalent antimeningococcal serum and frequently by type-specific antimeningococcal serum. Moreover, it seems that some strains, such as the one encountered in this case, do not give smooth suspensions in normal horse serum or normal rabbit serum, and so it is not possible to carry out agglutination tests with either antimeningococcal or antigonococcal serum. Strumia and Kohlhas agglutinated their strains of Gram-negative diplococci isolated from cerebro-spinal fluid to high titre with rabbit and antigonococcal serum and recorded a "±" agglutination with horse antimeningococcal serum; but they made no note of the organisms' behaviour in normal rabbit and normal horse serum. The fact that the organism in this case did not form a suspension in a 1/10 dilution of normal horse serum is against its being a meningococcus, as all known strains of meningococci give a smooth suspension.

Branham *et alii* attach considerable importance to the type of growth, pointing out that the meningococci give a much more luxuriant growth than the gonococci. Some strains of meningococci, however, give atypical, small, translucent colonies resembling the characteristic growth of the gonococci. Therefore growth characteristics may not always be of value.

Complement fixation is not specific, and fixation with a patient's serum only indicates an infection by a member of the Neisseria family and so is of no help in differentiation.

Therefore, in view of the association of a gonorrhœal focus with meningitis due to a Gram-negative diplococcus giving clear-cut fermentation reactions of the gonococcus, this case would appear to be one of gonococcal meningitis.

It is customary in laboratories doing routine work to regard as meningococci all Gram-negative diplococci isolated from the cerebro-spinal fluid which are agglutinated by polyvalent antimeningococcal serum. Since cross-agglutination of the Neisseria occurs and serological identification may for other reasons be unsatisfactory, it would perhaps be wise to investigate the fermentation reactions of Gram-negative diplococci isolated from the cerebro-spinal fluid. This is especially so in those cases of meningitis in which a gonococcal infection is known to be present and in outbreaks of meningitis in military camps, where both meningococcal and gonococcal infections occur.

Summary.

1. A case of gonococcal meningitis associated with a gonococcal focus in the genital tract is described.

2. Attention is drawn to the possibility that such cases are more common than is usually supposed.

Acknowledgements.

For permission to publish this case I am indebted to Dr. A. J. Collins, in whose care the patient was; and I should like to thank Professor H. K. Ward and Dr. N. E. Goldsworthy, department of bacteriology, University of Sydney, for their help and advice.

References.

(1) G. Henderson and W. T. Ritchie: "Gonococcal Meningitis", *Review of Neurology and Psychiatry*, Volume VII, Number 2, 1909, page 75.

(2) W. L. Bradford and H. W. Kelley: "Gonococcal Meningitis in Newborn Infant, with Review of Literature", *American Journal of Diseases of Children*, Volume XLVI, September, 1933, page 543.

(3) M. M. Strumia and J. J. Kohlhas: "Gonococcal Meningitis", *The Journal of Infectious Diseases*, Volume LIII, September-October, 1933, page 212.

(4) H. P. Marvin and W. E. Wilkinson: "Gonococcal Meningitis; Results of Treatment with Sulfanilamide", *The Journal of the American Medical Association*, Volume CX, March, 1938, page 809.

(5) S. E. Branham, R. H. Mitchell and W. Brainin: "Gonococcal Meningitis", *The Journal of the American Medical Association*, Volume CX, May 28, 1938, page 1804.

Reviews.

SURGERY OF THE HEART.

An event of considerable importance in the surgical world is the publication of E. S. J. King's "Surgery of the Heart". Although the surgery of the heart is still in its infancy, a great deal has been written about it. Up to the present these writings have been scattered in the different journals and books. For the first time the knowledge so far gained is now put down in one book.[1] The book is to a certain extent a compilation, but it is a compilation that has been done with a strong and well-balanced hand. It is in no sense, however, a compilation only. E. S. J. King is essentially a teacher, and throughout the book it is obvious that he is not only indicating work which has already been done, but is also pointing out the direction in which he thinks future work should go.

The book is divided into two halves. Section I deals with development, anatomy, physiology, pathology and special methods of investigations. This section is very useful to the reader, as he is able to get all the information he wants in regard to these matters without referring to other books. The essence of the book, however, lies in Section II, which is concerned mainly with surgery, as it is applied to the different diseases. It is in this section that the author is seen at his best. He writes with great clarity. His approach to the subject is wide. He is dogmatic, yet at the same time well balanced. This section includes the chapter on experimental investigations and describes King's own work in this connexion.

It may be thought that the surgery of the heart is a subject interesting only to specialists. The principles of the surgical approach to heart diseases have been so stated by the author, however, that it is clear that this section of surgery is an extension of general surgery and not only a specialty.

The bibliography is magnificent, and the printing and illustrations are excellent. There is no doubt that as knowledge advances this book will have to be rewritten in a few years. In the meantime it is one that no surgeon can be without.

PHYSICAL DIAGNOSIS.

LEWISON AND FREILICH have recently published a short book on some aspects of physical diagnosis.[1] "Some aspects" is emphasized, because, as the subtitle states, it is "with special consideration of the heart and lungs". In fact, the book is devoted almost entirely to the heart and lungs, which are extremely well considered. The remaining systems are discussed but briefly, receiving only passing consideration in the three introductory chapters, while the abdomen, genitalia, extremities and reflexes are disposed of in the last three chapters, which occupy only 24 pages out of a total of 300 odd. The book opens well with a systematic survey of the history and physical findings of a general examination, with brief reference to some of the more characteristic symptoms and their causes. The illustrative causes given, incidentally, appear to be chosen rather arbitrarily; for example, the list of "most common causes of jaundice tinting" does not include cholelithiasis, which might occur first to the clinician. Then follow six detailed chapters on the thorax and respiratory system, and eight on the heart and cardio-vascular system. These sections are very full and thorough and well illustrated, but they appear to contain very little that does not occur in other good books. This book can be recommended to those who desire a guide to the respiratory and cardiac systems in particular; but the average learner wants a compact presentation of all the systems in a single volume. The authors might well consider some revision of the major title, or else expand their consideration of the other systems.

[1] "Surgery of the Heart", by E. S. J. King, M.D., M.S., D.Sc., F.R.C.S., F.R.A.C.S.; 1941. London: Edward Arnold and Company. Medium 8vo, pp. 740, with illustrations. Price: 50s. net.

[1] "Manual of Physical Diagnosis, with Special Consideration of the Heart and Lungs", by M. Lewison, M.D., and E. B. Freilich, M.D., in collaboration with G. C. Coe, M.D.; 1941. Chicago: The Year Book Publishers. Large crown 8vo, pp. 317, with illustrations. Price: $3.00 net.

The Medical Journal of Australia

SATURDAY, FEBRUARY 21, 1942.

All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

Reference to articles and books should be carefully checked. In a reference the following information should be given without abbreviation: Initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.

Authors who are not accustomed to preparing drawings or photographic prints for reproduction are invited to seek the advice of the Editor.

NEURO-SURGERY IN AUSTRALIA.

BETWEEN six and seven years have passed since the subject of neuro-surgery was discussed in these columns. Although the last reference was prompted by the remarks of a visitor to these shores on the subject of anæsthesia, mention was made of a contribution to *The Australian and New Zealand Journal of Surgery* by Professor H. R. Dew, who has probably done more than anyone else to put neuro-surgery on a proper footing in this country. On the present occasion we have in this issue Professor Dew's Halford Oration on the ancillary sciences and neuro-surgery, and the time has come for a review of our present position. In the circumstances it will be desirable to discuss first of all the qualifications of a neuro-surgeon and secondly his *milieu* and the equipment with which he should be provided.

Present-day neuro-surgery may be said to have been established by Harvey Cushing. Others before him had devoted special time and study to surgery of the nervous system. P. C. Bucy has stated[1] that though Victor Horsley's main interests were concerned with the nervous system rather than with surgery, his pupils and successors were in the main general surgeons with little or no interest in the nervous system. This may or may not be entirely true, but it is certain that Cushing, as no one had done before him, insisted that the brain surgeon should have a knowledge of neurology while at the same time he widened the scope of neuro-surgery, amplified its teaching and with his master hand improved its technique. It is not so very long ago since a physician, who perhaps had a special interest in diseases of the nervous system, tried to localize a cerebral lesion from the signs and symptoms and stood by in anxious suspense while the surgeon performed an exploratory craniotomy in fervent hope rather than with certain expectation. The surgeon was the craftsman acting on the decision of the physician. Cushing changed all work of that kind. Professor Dew in his Halford Oration shows how the change has been accomplished, how by clinical observation, by adoption of the experimental method and by continual effort to improve technique the modern neuro-surgeon has gained a unique position from which he can not only attack certain diseases of the nervous system but try to discover their cause. It is clear that since the diagnosis, the decision regarding treatment and the carrying out of treatment are in the hands of the neuro-surgeon, he must be fully trained to undertake his responsibilities. This implies that he must be more than an operator, skilled in the use of his surgical instruments, he must be a neurologist, he must be trained in pathology and he must not have forsaken the planning and carrying out of experimental investigation. To those, if there are such, who would doubt the need for a neuro-surgeon to be a neurologist, it may be stated that opportunities to solve problems often present themselves to the neuro-surgeon before they come before anyone else. If he is not familiar with the field of neurology he will not recognize the opportunity when it comes. This does not mean that the neuro-surgeon is to be denied the help that he may gain from collaboration with a physician who has devoted special study to neurology. If such collaboration does take place, however, the participants should collaborate on an equal basis. This will not be possible if the surgeon has forsaken neurology. In other words the title neuro-surgeon should carry the implication that its user is a surgeon and a neurologist, not that he is a surgeon who operates on the nervous system. In regard to pathology the position is a little different. The neuro-surgeon, as already stated, should have a considerable knowledge of pathology, especially pathology of cerebral and spinal newgrowths, but this is not really sufficient for neuro-surgery as a science, though it may meet the needs of the practising neuro-surgeon. Bucy has stated with some justification that with the exception of our limited knowledge of the visual cortex and the precentral motor fields, neurology and neuro-surgery are operating largely on a decortical or decerebrate level so far as knowledge of the nervous system is concerned. This alone is sufficient reason to lead to the insistence that associated with every neuro-surgical clinic or group of neuro-surgical clinics, there should be a whole-time neuro-pathologist whose duties would include not only collaboration with neuro-surgeons in the clinical field, but also experiment and research on his own behalf as well as investigations deemed necessary after consultation with clinicians. Pathology has become such a vast subject that general pathologists cannot hope to cover the field of neuro-pathology as it should be covered; they recognize the need for specialism in the pathology of the nervous system, and this being so, any specialist of this kind in a community would naturally have a close liaison with neuro-surgical clinics in his vicinity. Professor Dew has mentioned in his Halford Oration several types of investigations, any one of which would provide scope for the most assiduous investigator.

When once we admit, and it would be foolish to deny, that a neuro-surgeon must be a highly equipped and specially trained person, the conclusion is inevitable that he should devote himself entirely to his work. But even that is not sufficient. There is need to consider the conditions under which he shall work. Nothing short of a complete and self-contained unit in a central hospital will

[1] *The Journal of the American Medical Association*, July 27, 1940.

meet the requirements. This is true particularly in regard to the removal of tumours of the brain. In 1933 Professor Dew declared that the provision of purely mechanical facilities comprised at least half the problem; this is just as true today as it was then. Equally important are the nursing facilities—the provision of beds in the vicinity of the operating theatre and the permanence of the nursing personnel in theatre and ward. Attention may also be drawn to the fact that when once a neuro-surgical unit is established and is known to be doing neuro-surgical work exclusively and doing it well, patients are referred to it by medical practitioners much earlier than they could otherwise be referred—patients suffering from tumour of the brain will be sent before increasing intracranial pressure has brought them or almost brought them to the stage of stupor. As an example of what may be accomplished with a properly planned and equipped neuro-surgical unit, reference may be made to the results obtained at the neuro-surgical unit of the Royal Prince Alfred Hospital, Sydney, a unit formed in 1938 as a result of Professor Dew's urgent recommendations. That such a clinic was necessary was clearly shown by the success that had been obtained at the clinics of Cushing and Dandy in America, de Martel, Vincent and Foerster on the Continent, and Jefferson and Cairns in England. Ever since its inception the usefulness of this clinic has extended over a wider sphere. It has now outgrown its accommodation of sixteen beds for adults and two cots. There is a long waiting list and an out-patient clinic is held twice a week; the clinic has a "follow-up" department. For an indication of the kind of work done at this clinic readers are referred to an article by Dr. Gilbert Phillips published in this journal on October 5, 1940. On that occasion Dr. Phillips reported the results of thirty-five successive intracranial operations, twenty-nine of which were performed because of the presence of intracranial tumours. Dr. Phillips has recently been good enough to supply figures which show that during the last twelve months approximately three hundred in-patients have passed through the department and one hundred and two major operations have been performed in the neuro-surgical theatre with a mortality rate of 8·8%. Over two hundred and fifty minor operations such as encephalography and ventriculography have been performed in the same period. But Sydney is not alone in its neuro-surgical clinic. Melbourne has more than one centre. At the Alfred Hospital Dr. Hugh Trumble has been in charge of a neuro-surgical ward for about ten years. At the end of 1939 a special block containing a ward of eleven beds and an operating theatre were set apart for neuro-surgery. The nursing staff attached to this block devotes its whole time to the care of neuro-surgical patients. During 1941 seventy-five patients were operated on for intracranial tumour; these were both public hospital and private patients. It is of interest to note that much of the special apparatus used in the unit has been designed by Dr. Trumble—such, for example, as the apparatus for the cutting of an osteoplastic flap, described in this journal by him in the issue of July 2, 1938. At Saint Vincent's Hospital, Melbourne, Dr. Frank Morgan is in charge of the neuro-surgical clinic, which has outdoor and indoor sections. The work of the two sections is coordinated so that there is no break in the continuity of treatment. Patients are admitted to the indoor department from the outdoor section and also directly from the general medical and surgical indoor clinics. The clinic is housed along with the general medical and surgical clinics and other special clinics as are conducted in conjunction with them. The nursing and theatre staffs are specially trained. During the last five years one hundred and seventy-nine intracranial operations have been performed, forty during 1941; sixty-four spinal operations have been performed. At the Royal Melbourne Hospital neuro-surgery has been regarded as part of the neurological unit. Dr. A. E. Coates (at present serving abroad) is the surgeon and the neurological and pathological side is under the care of Dr. Graeme Robertson. During 1940 seventy-five craniotomies were performed. It is both significant and satisfactory that for the period of Dr. Coates's absence on active service, arrangements have been made for Dr. Trumble and Dr. Morgan to operate on patients needing surgical care. We understand that in the new Royal Melbourne Hospital there will be a neurological out-patient department and that adequate provision will be made for beds and for a theatre for neuro-surgical work and also for a properly trained personnel. At the Royal Adelaide Hospital the neuro-surgical work is done by Dr. L. C. E. Lindon. There is no special neuro-surgical ward, but Dr. Lindon has the services of a clinical assistant; he has no special house surgeon, nursing sister or operating theatre. During 1940 and 1941 one hundred and thirty-eight neuro-surgical procedures of all kinds were carried out. In Brisbane no separate neuro-surgical unit has been established and the same holds true of Perth. The figures quoted for operations in all centres are all the more striking when we remember how seldom such operations were performed in this country a few years ago. We cannot believe that people are suddenly beginning to suffer from intracranial tumours and other surgical diseases of the nervous system, and we must therefore agree that the establishment of clinics of this kind does something towards the satisfying of a public need.

If by the present discussion we have shown that neuro-surgical work calls for a special type of surgeon, with special equipment and with special, separate and self-contained facilities for work, our object will have been gained. The work of neuro-surgery is exacting, and though the successes are often remarkable, the results may be disheartening. Surgeons who devote their lives to this kind of work need encouragement and they should receive it from both general and specialist practitioners. If support and encouragement are forthcoming the work will prosper. In the fullness of time neuro-surgery will force its own recognition, but this should not be necessary. Eventually it will be further subdivided into traumatic neuro-surgery and neuro-surgery not connected with trauma; that is a subject for future discussion.

Current Comment.

AIR RAIDS AND INJURIES TO THE EYE.

In many parts of Australia, particularly in closely settled industrial and defence areas, people are at considerable pains to protect their homes, their offices and their factories from damage by air raids. One of the

most urgent measures in such protective undertakings is to treat windows, and other structures in which glass is used, by the application of some material that will prevent shattered pieces of glass from flying in all directions. While our present intention is not to discuss ways and means of protecting windows, glass doors and so on, but to draw attention to the importance of such protection and to the dire results of failure to secure it, the opportunity cannot be allowed to pass to remind medical practitioners of the iniquity of the use of surgical gauze, butter muslin and similar materials as protective fabrics. This has been emphasized in this journal on more than one occasion at the request of the Medical Equipment Control Committee, and at the risk of being considered tiresome we mention the subject again. Since stocks of surgical gauze and butter muslin are low, and since these materials are not manufactured in Australia, there is every need to husband our resources. Medical practitioners should seize every opportunity of making these facts known to the general public. Once the facts are known, the people will not be so careless of their country's welfare as to ignore them.

In June, 1941, a discussion on the treatment of war injuries of the eye was held at a meeting of the Section of Ophthalmology of the Royal Society of Medicine; the account of the discussion is published in the *Proceedings* of that body for September, 1941. The views expressed were so important that some account of them should be presented for the use of Australian practitioners. The principal paper was read by T. M. Tyrrell, who said bluntly that glass injuries were the chief bugbear of air raids. Harold Ridley, in the discussion, amplified this by stating that eye injuries caused by air raids were most serious, for not only were both eyes frequently involved, but the injuries were more often complicated than in civil practice. Since prevention is more important than cure, it will be well to refer first of all to one of Tyrrell's conclusions. He holds that to prevent eye injuries a vigorous campaign is needed to inform the public of the dangers of flying glass. Reports from England tell of the most shocking injuries caused in this way, and it is clear that injuries to the eyes may cause permanent disability. The public in this country will never be able to complain that it has not been warned of the dangers, for departmental officers and others, as well as the daily newspapers, have done their duty in this respect. If the public wants further details to awaken them from lethargy, some of the cases mentioned in the London discussion may fill the bill. Tyrrell makes the sensible suggestion that shopkeepers should be prevented from replacing broken windows with yet more glass. He also holds that firemen and fire watchers should have a protective visor to keep flying débris out of the eyes. If anything of this kind is to be done in this country, the authorities will need to bestir themselves. It may be that they have never had the suggestion made to them; but, be that as it may, we have still to see wardens wearing "tin hats" in a trial "blackout". These must come before a visor attachment can be added. And a trial blackout may become a real affair at very short notice or with no notice whatever.

So much for the preventive side. In regard to actual treatment Tyrrell begins with the remark that in ten months of heavy air attacks on London he has learned that peace-time methods of treatment of eye injuries do not apply very well. He first of all found that because he was not able to be in two places at once, some of the patients had to be allowed to wait for treatment. He discovered that although a badly injured eye was allowed to wait for twenty-four hours for treatment, it was still possible to obtain a good result. He then found that it was easier to deal with patients who had been allowed to wait. Soon he began deliberately to leave patients unoperated on and apparently obtained better results. His explanation, and no doubt it is the correct one, is that after the lapse of time shock passes off and the patient is in better condition to withstand operation. Persons injured in air raids are more shocked than are those met with in civil practice whose eyes have been damaged. In the subsequent discussion Affleck Greeves agreed with these views.

Tyrrell then pointed out that the unfortunate people who were injured in air raids were always in an extraordinarily grimy condition. The dirt appeared to have been blown deep into the pores of the skin, and the conjunctival sacs were usually filled with "a slimy mud-pie made up of mucus and dirt". He thought that such eyes should be subjected to irrigations every two or three hours with an alkaline lotion before any operative interference was attempted. At the time of operation it is his practice to irrigate the conjunctival sac with a 2% solution of silver nitrate for long enough to produce a slight film of white over the corneal surface. This film, in his opinion, forms a protective coat over the particles which may be embedded in the cornea or conjunctiva, and helps to prevent infection. In the discussion Victor Purvis said that Tyrrell's 2% solution of silver nitrate to be used as an irrigating fluid was rather strong. He had found that a 1 in 1,000 solution was successful; it would, for example, make an intraocular operation quite safe in the presence of a pneumococcal culture. If a decision had to be made on this point, most ophthalmologists would agree that a strong solution should not be used if a weaker one was efficient.

Tyrrell divided war injuries of the eyes into three groups: (*a*) non-penetrating injuries, comprising dust and débris in the conjunctival sac, glass in the conjunctival sac, and concussion injuries of the globe; (*b*) penetrating but not perforating injuries, comprising wounds of the lids, corneal foreign bodies, burns of the cornea and of the lids and conjunctiva, glass in the cornea, glass in the sclera, subconjunctival metal or dust or other foreign matter; (*c*) perforating injuries, caused by metal, glass or other matter, and affecting the cornea, the corneoscleral junction and the sclera. In regard to non-penetrating injuries, Tyrrell referred again to the cleaning out of the conjunctival sac and insisted that all glass had to be removed; he added that it usually had to be picked out, as it was the most tenacious of all conjunctival foreign bodies. He divided concussion injuries of the eye into hyphæmia, torn iris, torn lens capsule, dislocated lens, vitreous hæmorrhage, detached retina and *commotio retinæ*. These were treated in the usual way. Of the penetrating but not perforating injuries, wounds of the lids are, in Tyrrell's opinion, fairly common and by far the most difficult to treat. In his experience they nearly all become septic unless the wound edges are excised "and with the lid there is not much left to excise when there is a big gash in the tissues". He generally cleans the edges of the wound with peroxide of hydrogen and cuts out all obviously damaged tissue that is not likely to survive; when he is in doubt he does not sew up the edges. The most difficult cases are those in which the tarsal plate is damaged; so far Tyrrell has not tried the correct treatment, which is tarsectomy. When multiple foreign bodies are present in the cornea Tyrrell does not touch them. He instils oily atropine and later paroleine drops, and the foreign bodies "rapidly fall out". For burns Tyrrell agrees with other observers that tannic acid is dangerous; the violet dyes have given good results. Burns of the cornea are very uncommon. He refers to a hero in one of Jules Verne's books, who had his eyes put out with red-hot irons, and owing to the film of tears over the cornea, which turned into steam, it was found later that the cornea had not been burned at all. Tyrrell has had a case such as this, when a boy who ran a stream of molten lead into his eye, recovered with a clear and bright cornea. W. G. Davidson in discussion said that he had had a similar experience with molten metal in the eye of a patient whose corneal epithelium remained intact. In discussing perforating injuries, Tyrrell said *inter alia* that he had had to treat 20 to 25 severe perforating glass injuries and had had to remove ten eyes which were too pulped to be saved. The majority of the others were cases in which the glass had perforated the cornea or sclera and had fallen out again. All that was necessary was a clean-up, iridectomy and a conjunctival flap.

Only the points in the discussion which seemed to be of the greatest general interest have been mentioned here; ophthalmologists will be repaid by perusal of the original report.

Abstracts from Medical Literature.

OPHTHALMOLOGY.

Chemotherapy in Trachoma.

A. R. McKELVIE, R. KIRK AND H. J. HELDER (*American Journal of Ophthalmology*, September, 1941), writing from Khartoum in the Anglo-Egyptian Sudan, report their observations on the chemotherapy of trachoma. They state that the work is incomplete, but that they thought it inadvisable to defer publication on account of the conditions of war in East Africa. They find that sulphonamide therapy has little or no effect in certain cases of trachoma; it produces a variable degree of improvement in others, and in some instances effects a rapid and very dramatic clinical improvement. When it is really effective, sulphonamide therapy from the patient's point of view is infinitely preferable to any other form of treatment. The effects of sulphonamide therapy are most dramatic when the disease has produced serious clinical manifestations, that is to say, in those cases in which an effective therapeutic agent is required. In "sub-clinical" trachoma, in which vision is unaffected, in which the patient has no subjective symptoms and the condition is discovered only by careful clinical examination, sulphonamides appear to have little or no effect. It does not follow that these conclusions, which apply to a population in which the infection may possibly have been endemic for centuries, would be applicable in other parts of the world. The authors find that the rapid clinical improvement described by them is not necessarily associated with the immediate disappearance of the Halberstaedter-Prowazek or H.P. bodies. The authors state that sulphonamide therapy, without eliminating the infection, enables individuals in whom the infection is pathogenic to deal with it as if it were non-pathogenic. In sub-clinical trachoma the infection is already non-pathogenic or only mildly pathogenic, and so the effect of sulphonamide therapy is not so dramatic. MacCallan has attempted to explain the effect of sulphonamide therapy in trachoma on the assumption that the sulphonamides have no action whatever on trachoma, but that the beneficial results observed clinically are entirely due to the effect of the drug on superimposed bacterial infection. This would imply that pannus, keratitis and the like are the result of secondary infection, and that trachoma itself is a non-pathogenic or only mildly pathogenic infection of no clinical importance. The authors' observations are consistent with this hypothesis; but they doubt whether many workers will accept this view of trachoma without more conclusive evidence.

Retinopathy in Diabetes.

G. WHITE AND C. E. A. HASSARD (*The Canadian Medical Association Journal*, June, 1941) state that since Hirschberger in 1890 described a central punctate retinitis in a diabetic, this picture has become associated with a retinopathy occurring in diabetes. In this condition deep, round, punctate hæmorrhages are present in the macular region. These hæmorrhages may be quite numerous or only few in number. Associated with them are small yellow exudates, and these, from the similarity of their shape and situation, are probably the result of hyaline degeneration occurring in old hæmorrhages. At a later stage these yellow exudates tend to coalesce, forming larger patches or plaques, and to be deposited in a circular area around the macula. The disk is normal or nearly normal; the vessels show only a mild grade of arteriosclerosis or none at all; and in the typical case there is no retinal œdema or cotton-wool exudate. There has been much argument as to whether these changes are the direct result of diabetes or the result of cardio-vascular or renal disease entirely independent of any diabetes which may be present. In an investigation of 100 diabetic patients the authors found that the incidence of retinopathy increased with advancing age, with the duration and severity of the diabetes and with the association of cardio-vascular and renal disease. There were, however, in the series, six cases of retinopathy in which no cardio-vascular or renal disease was present, and the main factor in this group appeared to be the severity and control of the diabetes. This factor, however, cannot, in the authors' opinion, be responsible for all cases of retinopathy. The only factor so far discovered, common to all cases, is the diabetes itself. Until some other factor is discovered, diabetic retinopathy must be considered a clinical entity, in which the vessel walls of the diabetic are affected by some factor other than, and in addition to, those operating in cardiac disease, hypertension and nephritis.

The Use of Vitamin C (Ascorbic Acid) in Inflammatory Conditions of the Cornea.

T. K. LYLE AND D. W. MCLEAN (*The British Journal of Ophthalmology*, June, 1941), working independently in Royal Air Force hospitals, have used large doses of ascorbic acid in the treatment of inflammatory conditions of the cornea. Their cases number ten, and they came to the following conclusions. (i) In corneal conditions involving ulceration, superficial type of keratitis and chronic corneal opacities, treatment with ascorbic acid has a beneficial effect, the improvement in most cases being almost dramatic. (ii) In most cases treated there was no reason to believe that a general vitamin *C* deficiency existed. It therefore appeared that the beneficial results were obtained by the flooding of the blood stream with an excess of ascorbic acid. (iii) The method was of no value in the treatment of iritis; it appeared in some instances that the ascorbic acid had a detrimental effect. (iv) The method caused no general or local reactions. The dose given was 500 milligrammes a day. The injections were given intravenously, and this dose should, in the authors' opinion, be continued until active inflammation of the eye has disappeared. In all the cases reported by the authors the ordinary local treatment was given in addition to the injections of ascorbic acid.

Hereditary Optic Atrophy.

J. GRAHAM SCOTT (*The British Journal of Ophthalmology*, October, 1941) has made a study of two families totalling over 250 members, 61 of whom suffered from optic atrophy. He has, for purposes of convenience, divided one family into two, and he publishes a genealogical tree of each. The two families live in the same district, but no relationship is claimed. The individual members of the family are healthy, industrious and long-lived, and no family defect other than optic atrophy is present. There is no sign of mental deficiency and no obvious endocrine dysfunction. There are no signs of syphilis. The 61 persons affected comprise 32 males and 29 females. Inheritance was direct from affected male or female. The onset occurred at about three years of age and was gradual and unnoticed. Colour vision was not lost early. The base of the "hill of vision" was normal, but the peak was lost. The disk was white, the edges were clear-cut and a deep cup was present. The remainder of the fundus was normal, except for the absence of the normal light reflex at the macula.

Glaucoma and the General Practitioner.

PAUL A. CHANDLER (*The New England Journal of Medicine*, October 16, 1941), in an article on glaucoma and the general practitioner, points out that this condition causes about one-third of all blindness in patients past middle life. He discusses the ætiology and describes the signs and symptoms. He insists that if there is the slightest doubt whether the case is one of acute iritis or acute glaucoma, it is best not to give any treatment at all. In an attack of acute glaucoma one drop of atropine may mean the ruin of an eye, for the effect of the atropine is not only deleterious, but cannot be overcome by myotics. The author insists that patients who are past middle life should have a thorough examination of their eyes at least once every two or three years. Most cases of chronic glaucoma are discovered in such routine examinations. It makes no difference whether the patients are known to have partial loss of sight from retinal disease or incipient cataract; glaucoma can exist with any disease of the eye.

C. F. NUTTER, in discussing the paper by Chandler, said that he had seen cases of glaucoma in which the tension was reduced to normal, but in which progressive blindness occurred, so that later on the eye was of no use. It might be possible to find some reason for this condition; but he believed that some element was present with which ophthalmologists were not very familiar.

OTO-RHINO-LARYNGOLOGY.

Bronchoscopic Aspects of Carcinoma of the Lung.

R. H. BETTS (*The New England Journal of Medicine*, October 2, 1941) holds that bronchial newgrowths are not only diagnosed more often, but appear to be increasing in frequency and should always be suspected, especially when a cough, wheezing, hæmoptysis or atelectasis are not satisfactorily explained. In 75% of cases the lesion is in the larger bronchi and may be seen through the bronchoscope long before it is large enough to be localized clinically or to give radiographic evidence of its presence. In the remaining 25%, the group comprising the peripheral tumours, although the tumour may not be visible, bronchial deformity will be detected in many and is a valuable supporting sign. Biopsy examination may be possible in many cases. A further important point is that with the bronchoscope it is possible to determine suitability for operation or to decide upon and to provide access for radia-

tion treatment. One of the commonest sites is in the right upper lobe bronchus. With the bronchoscope it is possible to show that in a number of such cases extension has involved the trachea. In others the carina and even the left main bronchus may be involved. Operation even to the extent of pneumonectomy would be hopeless in such instances. With mediastinal gland involvement a broadening of the carina, or rigidity and fixation, may often be demonstrated with the bronchoscope. Occasionally pedunculated tumours may be removed through the bronchoscope, while in other cases radium may be applied, or it may be possible to give temporary relief from lobular atelectasis by removing segments of growth which are causing bronchial obstruction.

Acoustic Trauma in Man.

H. B. PERLMAN (*Archives of Otolaryngology*, September, 1941) has made a clinical study of a number of persons in whom hearing loss was associated with various types of noise; he also makes some experimental observations. The clinical cases, 30 in number, are divided into three groups. Four were associated with a single explosive sound. Fifteen of the patients had been in an environment of rapidly repeated or continuous sound, and in eleven cases there was a history of association with more slowly repeated discrete sound impulses, such as from firearms, a trip hammer, dynamiting *et cetera*. In nearly all cases audiometric examination revealed the greatest hearing loss at 4,096 cycles. Experiments were carried out in the division of otology of the University of Chicago, with the object of determining the fatiguing effect of loud pure tones on the threshold curve. Three to six normal young adults were used for each frequency studied, and the stimulus was applied for one hour. Monochord tests and audiograms were made immediately before and after exposure to sound stimuli and again until there was complete recovery. Conclusions arrived at were as follows: (i) low tones produce less acoustic trauma than those of higher frequency and of approximately equal intensity; (ii) the greater depression of subsequent perception was not at the frequency of the fatiguing tone, but was usually found to be in the octave above the fatiguing tone; (iii) petrolatum-treated cotton provides limited protection from acoustic trauma; (iv) tinnitus was of variable duration and was often of a pitch an octave above that of the fatiguing tone. Some analysis is given of experimental work by others on the nature of pressures produced, rate of propagation of pressure waves and sound waves in heavy gunfire, and it is suggested that a pulse of such intensity, even though of very short duration, may initiate molecular displacements violently affecting the cochlea before the middle ear muscles can contract. Some of the factors which influence the degree of hearing loss are set out. Exposure to sound trauma may after years result in only a slight localized drop in the threshold curve without noticeable impairment of hearing. The ear can recover with rest. Lack of rest periods is conducive to greater trauma. It is likely that only loud sounds cause damage to the ear. Older persons are probably more susceptible than the young. Other qualities of the sound stimulus, such as a relatively slow rate of interruption, or a sharpness of onset, such as occurs in explosions, may influence the damage produced by reason of the latent period before the protective contraction of the tympanic muscles takes place, permitting greater violence to reach the cochlea. Exposure in an enclosed space, by reason of reflection, especially from smooth hard walls, may cause greater trauma than in the open.

Thrombosis of the Lateral Sinus.

LOUIS HUBERT (*The Journal of the American Medical Association*, October 25, 1941) reports clinical observations made in a series of 119 cases of thrombosis of the lateral sinus occurring in patients admitted to the Manhattan Eye, Ear and Throat Hospital over a period of twelve years. The cases are divided into two groups, 95 occurring during the eight years preceding the use of sulphonamides and 24 occurring during the four years since these drugs have been in use. During the twelve years 6,837 mastoidectomies were performed. The total number of cases of thrombosis of the lateral sinus was 119 (1·7%). The right sinus was involved more often than the left. Of these infections, 38% occurred in patients of the first decade, the incidence tending thereafter to decrease, especially after the twentieth year. In elderly patients the condition seems to be rare. In 35 cases the walls of the sinus appeared healthy, yet with incision of the sinus wall a thrombosis was found in eleven instances. That perisinus abscess should always give reason to suspect a thrombosis is revealed by the fact that a clot was found in 26 of 37 such cases. From the first series of cases it was revealed that metastases were more common in acute thrombosis and appeared with much greater frequency after operation; there were no metastases in the second series. Amongst diagnostic features the characteristic temperature curve, rigors, sweating, metastatic abscesses, progressive anæmia and blood cultures were demonstrated. Severe boring pains, apparently due to the thrombosed sinus alone, were noted in fourteen instances. Of 42 cases in which the optic fundi were examined, there was no change in 25, while changes, such as dilatation of veins, optic neuritis and papilloedema, were present in 17. In two cases there were no clinical signs of sinus thrombosis, the condition being discovered only at operation. Blood cultures were obtained in 51 cases of the first series and in ten of the second, thus revealing that failure to obtain a culture does not exclude thrombosis. The author advises early operation based on clinical findings rather than to delay until a blood culture is obtained. He quotes from the two series of cases, the comparative mortality rates when operation on the sinus was undertaken at the time of mastoidectomy or was delayed until the first, second or third week afterwards; these were 1·4%, 22·8%, 28·5% and 42% respectively. In regard to the mortality of the two series, 31 patients died out of 95 treated before the use of sulphonamides, and three out of 24 treated since these drugs were in use. The author utters a warning against the masking effect of sulphonamides; he advocates early exploration of the sinus and removal of the thrombus. The chemotherapy should be continued for at least a week after clinical cure is apparent, sufficient dosage being used to maintain a blood concentration of seven to ten milligrammes per hundred cubic centimetres. Whereas ligation or resection of the jugular vein was practically a routine procedure in the earlier series of cases, the present tendency at the Manhattan Hospital is to operate on the lateral sinus, and if sepsis continues or if progress is unsatisfactory, then to consider operation on the vein in the neck.

Abscess of the Mandibular Fossa Secondary to Otitis Media.

H. I. LILLIE AND K. S. SIMONTON (*Archives of Otolaryngology*, September, 1941) state that only two cases of abscess of the mandibular fossa have been observed in the Mayo Clinic. These two cases form the basis of their report. Record of five cases was found in the literature. Of the seven, six were otogenic and one was of dental origin. Infection is believed to reach the mandibular fossa via the Glaserian fissure rather than from the breaking down of zygomatic cells. In the two cases at the Mayo Clinic the lesion was a subperiosteal elevation of the articular capsule, and suppuration did not actually take place within the articular space. The initial symptom is severe deep-seated pain in the region of the joint. The pain is greatly increased by movement of the jaw and is stated to be more severe than the pain of the zygomatic abscess. Swelling and tenderness are similar in both conditions. From the temporo-mandibular fossa extension of infection through the parotid gland may reach the pterygyo-maxillary fossa, causing further trismus and pain on swallowing. In treatment the mastoid incision is extended above and around the upper attachment of the ear, exposing the zygomatic root, where cells may be sought. An incision into the periosteum is carried along the lower aspect of the zygoma to a point just beyond the articular eminence. Pus may escape as the periosteum is elevated from the lower surface of the zygomatic root. When necessary to expose deeper tracks further or to reach the source of infection, a wedge of bone may be removed in the direction of the middle ear down to the site of opening of the Eustachian tube. Suitable drainage is to be provided until infection is overcome.

Modern Treatment of Acute Tonsillitis by Injection of Bismuth Compounds.

ARISTIDES MONTEIRO (*Archives of Otolaryngology*, October, 1941) in 1934 first reported the treatment of acute tonsillitis by the injection of bismuth compounds. He quotes numerous favourable reports published since that time by others and claims continued success with his own cases. Streptococcal infection is most responsive. That due to staphylococci, the diphtheria bacillus or pneumococci is uninfluenced. Peritonsillar abscess apparently cannot be aborted by the method. Secondary cervical adenitis is rapidly relieved. It is claimed that the most useful application is in children, in whom the course of disease is shortened from six to eight days to twenty-four or forty-eight hours. Dosage is in accordance with the patient's age and the solubility of the bismuth preparation employed. For young infants one to five milligrammes of a soluble preparation or 10 to 20 milligrammes of an insoluble preparation, according to age, are used. The adult dosage should not exceed 20 milligrammes of soluble compound per twenty-four hours or 50 milligrammes of an insoluble compound in each dose. Cardio-renal disease or a severe affection of the renal apparatus are the only contraindications.

British Medical Association News.

SCIENTIFIC.

A MEETING of the Queensland Branch of the British Medical Association was held at the Hospital for Sick Children, Brisbane, on May 15, 1941. The meeting took the form of a series of demonstrations by members of the medical staff.

Spontaneous Blindness.

DR. E. O. MARKS showed a boy, aged ten years, who had lost the sight of both his eyes on April 22, 1941. He could see normally prior to that date. On April 20, 1941, his mother had noticed that his eyes were dilated and bright and rather red. Two days later, on waking in the morning, the boy complained that everything was blurred and dark. His upper lids were swollen and painful. He did not feel well and spent the day in bed. Next day he wanted to sleep all the time. His pupils were dilated and everything seemed shadowy to him. On the next day he could see nothing whatever.

On examination the pupils were widely dilated and did not react to light. Slight papilloedema was present on both sides of less than one dioptre. Upward rotation of the eyeballs seemed to be difficult. There was complete and total blindness. No other abnormality was found on examination. The Wassermann test produced no reaction. An X-ray picture of the sinuses revealed some opacity of the right antrum, interpreted as mucosal thickening, and possible bilateral ethmoiditis. At the time of the meeting the patient's condition had improved a little, and he could count fingers. His pupils were a little smaller, but did not yet react to light, and the papilloedema had disappeared.

Dr. Marks said that the diagnosis of his condition was in doubt, although the location of his lesion (whether inflammatory, toxic or due to pressure) must be somewhere in front of the mid-brain; otherwise the pupil would have reacted normally to light.

Cerebral Tumour.

DR. S. F. MCDONALD showed a girl, aged three years, who had first come to the hospital two months previously. Vomiting had been present for twelve weeks, her voice had been nasal for about six weeks, and she had dragged her left foot for one week. When examined at that time she had some palatal weakness and paresis and slight spasticity of the left leg, with exaggerated tendon reflexes and an extensor plantar response. The optic fundi were normal. She could walk quite well.

While she was in hospital her condition had steadily become worse. Although not much vomiting was present, she was drowsy and apathetic. She could no longer walk or stand unsupported. Both the left leg and the left arm were paralysed and spastic. The left foot was in the equinus position and the left hand had developed the characteristic claw-like deformity of upper motor neurone lesions. The left side of the face was paralysed, and both her speech and swallowing had become difficult owing to the palatal weakness. With all these symptoms there was apparently no great increase in intracranial pressure, and apart from slight fullness of the veins no change was apparent in the optic fundus. For this reason Dr. McDonald considered that the patient had a rapidly growing tumour in the right subcortical region. He pointed out that the case was unusual, in that the great majority of intracranial tumours in children occurred below the tentorium, and that cerebellar defects and evidence of increased intracranial pressure were among the earliest symptoms. The child's parents had refused an operation, and the outlook was hopeless.

Influenzal Meningitis.

Dr. McDonald's next patient was a boy, aged fifteen months, who had been admitted to hospital two weeks previously. His illness had commenced on the day before his admission, with general irritability, repeated vomiting and a stiff neck. He had a temperature of 102° F. and looked ill. The cerebro-spinal fluid was turbid, containing a large number of leucocytes, an excess of globulin, no sugar and a number of Gram-negative bacilli. On culture these proved to be *Hæmophilus influenzæ*. As the boy was vomiting, glucose solution (5% in half normal saline solution) was given by the continuous intravenous drip method. Sufficient "Thiazamide sodium" (sulphathiazole) solution was added to make the dose half a grain intravenously every four hours. At the end of two days his condition was rather worse, although the number of bacilli in his cerebro-spinal fluid was much reduced. The dose of sulphathiazole was increased to one tablet every four hours. Two days later the cerebro-spinal fluid was sterile. As he had ceased vomiting, the intravenous drip therapy was ceased on the fifth day.

In view of the tendency of such patients to relapse, large doses of sulphathiazole were continued, alternating with sulphapyridine. A close watch was kept upon his white cell count, which remained above normal. At the time of the meeting the boy had received 40 grains of sulphathiazole and 32 grains of sulphapyridine. He was eating well and looked well, although his neck was still somewhat stiff. The cerebro-spinal fluid had remained sterile. Dr. McDonald commented upon the infrequency with which such patients recovered.

Goitre.

On behalf of DR. C. TUCKER, DR. F. W. ARDEN showed a girl, aged eight years, suffering from enlargement of the thyreoid gland. The swelling in her neck had appeared eight months earlier, and since then she had exhibited mild symptoms of hyperthyreoidism. She was nervous and easily tired. Slight tremor of the fingers was present, and the pulse rate, even when she was at rest, was seldom below 100 per minute. She had no exophthalmos and she was gaining in weight. Her mother had undergone partial thyreoidectomy for a toxic goitre some fifteen years previously. The girl's thyreoid was firm and smooth and moderately enlarged. Dr. Tucker considered, in view of the early onset of symptoms of hyperthyreoidism and of the family history, that she should be submitted to partial thyreoidectomy at an early date.

Empyema.

DR. F. W. ARDEN showed a girl, aged two years, who had been admitted to hospital at the end of April, 1941. She had caught a cold a week before, and soon developed a cough and rapid breathing.

On examination the child looked very ill; she was pale, cyanosed and restless, with a temperature of 103·6° F., a pulse rate of 160 per minute and a respiration rate of 80 per minute. She was grunting while breathing. Consolidation of the upper part of the lower lobe of the right lung was found. The child was treated with sulphapyridine, one tablet being given every four hours. Oxygen was given continuously and brandy was administered. She was desperately ill for some days; the temperature remained elevated despite an increase in the dosage of sulphapyridine to two tablets every four hours. Administration of this drug ceased on the fifth day. On the sixth day signs of fluid were discovered on the right side, and four and a half ounces were aspirated; *Staphylococcus aureus* grew on culture. On the seventh day the hæmoglobin value of the blood was found to be only 55%; the white cells numbered 40,000. A blood transfusion was given and a further four ounces of pus were aspirated. On the eighth day the child was better; two and a half ounces of pus were aspirated. On the ninth day another two and a half ounces of pus were aspirated. Then there began a gradual improvement, with frequent aspirations. On the sixteenth day a second blood transfusion was given, after which an attempt was made to drain the cavity with a de Pezzer catheter between the ribs. No pus drained, and the catheter was removed two days later. On the seventeenth day sulphathiazole treatment was started, and since then there had been steady improvement. The child had gained one pound in weight in the past three weeks. Some pus was still present, half an ounce being obtained at aspiration. An X-ray film revealed a large shadow, possibly pleural thickening. The question was whether aspiration and sulphathiazole treatment should be continued, or whether a thoracotomy drainage operation should be performed.

Dermatitis.

On behalf of DR. B. B. BARRACK, DR. F. W. ARDEN showed a boy, aged five years, who had been admitted to hospital from Casino, New South Wales, on September 9, 1940. For eight months he had had eczema of the scalp. He was treated in various ways. For six weeks before his admission he had been given sulphapyridine, half a tablet three times a day. Two days before his admission to hospital a red rash appeared all over the body.

On examination the child looked very much as he did at the meeting; desquamation was taking place all over him, the skin was bright red, and he had conjunctivitis. He had an irregular temperature to 100° or 101° F. in the evenings, which was lower in the mornings. He was treated with a

variety of baths and lotions, none of which effected any improvement. However, with many "ups and downs" his condition gradually improved. He then had what was taken to be measles in December, 1940. His temperature rose to 106° F.; this, however, did not worry him; in fact, it seemed to do him good. Thereafter his condition improved rapidly and he was discharged at Christmas time, almost well.

He was readmitted to the hospital on February 9, 1941, in as bad a condition as ever, red and scaly from head to foot, and he had been the same ever since. The Wassermann test failed to produce a reaction, and a blood count revealed that 6% of the leucocytes were eosinophile cells. He was given "T.A.B." vaccine on the analogy of the benefit following measles, but without effect. Dr. Arden asked for suggestions as to what was to be done with him next.

Spinal Tumour.

DR. W. MONZ showed a boy, aged one year, who had a spinal tumour producing signs of compression myelitis with or without a degree of hæmatomyelia, and associated with a rapidly growing pulmonary tumour. He had first come to the hospital on March 10, 1941, with a history of having fallen from a chair a week previously; the only thing noted was that his gait was a trifle unsteady. On March 12, 1941, he did not want to sit or stand, and cried when he sat down, crawled or tried to turn over. The next day he could not stand and was admitted to hospital.

On examination he was found to be a well-nourished child who was disinclined to stand. The knee jerks were active and no abnormality was found in the heart, chest or abdomen. His gait was ataxic and an X-ray examination of the hip joints revealed no abnormality. An irregular temperature was noted during the next week. "M & B 693" tablets were administered. The urine was examined microscopically and was clear. Several days later occasional pus cells were reported. On March 26, 1941, the development of a cough led to a closer examination of the chest, when some doubtful crepitations were heard at the bases of both lungs. The skull was radiologically examined, but no lesion was found, and the fundi were normal on examination. The Weil-Felix test produced no reaction.

On April 7, 1941, full examination of the nervous system revealed absence of abdominal reflexes and an exaggerated left knee jerk; there was a doubtful Babinski response, with a tendency to a withdrawal reflex, and apparent lack of sensation to pain was noted. In contradistinction to the exaggerated tendon jerks there was no patellar or ankle clonus; the lower limbs appeared then to be more flaccid than spastic; there was no fibrillary twitching. The child was unable to stand and the anus was patulous. A diagnosis was made of tumour of the spinal cord with secondary deposits in the lungs. The chest was radiologically examined next day, and the radiologist reported that the appearance was that of an interlobar collection of fluid or pus. The radiologist further stated that if this did not agree with the clinical findings, the presence of a dermoid cyst would have to be considered. The film revealed an opaque area the size of a hen's egg or a little larger, extending above the upper border. A blood count at this stage revealed 4,200,000 erythrocytes per cubic millimetre, a hæmoglobin value of 74% and a colour index of 0·8. The leucocytes numbered 10,000 per cubic millimetre; 56% were neutrophile cells, 42% were lymphocytes, and 2% were eosinophile cells. On April 10, 1941, cisternal puncture was carried out under ethyl chloride and ether anæsthesia; eight cubic centimetres of lipiodol were injected after withdrawal of some fluid for examination. The fluid gushed from the needle at first and then the flow ceased. The Queckenstedt test was without result and the fluid appeared to be clear. A radiograph taken then revealed complete block to the passage of lipiodol at the level between the third and fourth dorsal vertebræ. The pathological report on the fluid obtained by cisternal puncture indicated a cell count of one per cubic centimetre; there was no increase in globulin content, but sugar was present and the Wassermann test produced no reaction. The report on the fluid from the lumbar puncture stated that no cells were present and that the Wassermann test produced no reaction. The blood failed to react to the Wassermann test. A further X-ray examination of the lungs revealed a diffuse edge to the tumour in the lung, which had grown larger; there was also fluid with atelectasis at the base of the left lung. This film, taken on May 2, 1941, confirmed further clinical findings and revealed the heart displaced. The lipiodol remained arrested at the same level in the spinal canal, and there was a spread of the fluid into the thecal canals of the spinal nerves of that level. On May 13, 1941, a lumbar puncture without anæsthesia resulted in the withdrawal of no more than two drachms of straw-coloured fluid. Compression of the jugular veins produced no result. The pathological report on this fluid stated that the protein content was very high; a small clot formed when it stood overnight.

There appeared to be no direct connexion between the two tumours. X-ray examination revealed no bony involvement of the vertebræ. The primary tumour was undoubtedly the tumour of the cord, originating in the cord or thecal elements. There had presumably been some recent hæmorrhage into the spinal tumour to account for the sudden appearance of definite clinical signs. It appeared to involve both posterior columns, the lateral spino-thalamic, both anterior and posterior spino-cerebellar columns, the pyramidal tracts and the rubro-spinal tracts. The level of cutaneous anæsthesia extended right up to the level of the lesion, where there appeared to be hyperæsthesia. Scratching of the skin produced the sign *tache cérébrale*, and during inspiration there was recession of the lower five or six intercostal spaces. Cases of spinal tumour appeared to be rare in infants, and although the outlook seemed hopeless, the patient had been transferred to the deep X-ray therapy department of the Brisbane General Hospital.

Muscle Transplantations.

DR. H. CRAWFORD showed a girl, aged five years, who had been admitted to the hospital from the Rockhampton Hospital, where she had had acute anterior poliomyelitis. On her admission there was almost complete paralysis of the muscles of the right shoulder girdle, arm and forearm. After some time some degree of recovery was noted; finally a practically non-acting right deltoid was left. On February 25, 1941, a transplant operation was performed. The trapezius fibres were transplanted through the deltoid fibres and now assisted abduction. The child could now almost raise the right arm over her head, and the right deltoid seemed to be growing stronger. Improvement was still taking place.

Dr. Crawford's second patient was a boy, aged eleven years, who had been admitted to the hospital on December 12, 1940, with a history of deformed legs and right hand since birth; the confinement had ended with a forceps delivery and a birth injury. The mother stated that the child's mentality was bright, but the admitting officer considered it considerably below normal.

Examination revealed a right-sided paresis, with a right *talipes equinus* and *pes cavus*; wrist-drop was also present on the right side. The Wassermann test produced no reaction, and the blood count revealed no abnormality. On December 16, 1940, an X-ray examination revealed severe *talipes equinus* with some rarefaction of the bones of the foot. An operation was performed on December 17, 1940, when a multiple arthrodesis of the right foot and a sliding tenotomy of the *tendo Achillis* were performed. Direct examination revealed gross deformity with rarefaction of the talus and displacement of the muscle tendons. The flexion deformity of the right wrist was thought to be due to an overacting *flexor carpi ulnaris*. On December 30, 1940, an X-ray examination revealed no apparent gross deformity in carpal bones. On January 21, 1941, an operation was performed. This consisted of the following stages: (i) a transplant of the *pronator radii teres* tendon to the tendons of the *extensor carpi radialis longus* and *brevis*, (ii) a transplant of the *flexor carpi ulnaris* tendon to the tendon of the *extensor carpi ulnaris*. On February 24, 1941, an X-ray examination revealed a satisfactory position. On May 15, 1941, the child's mental condition was regarded as completely normal; the movements of the hand were still improving.

Acute Nephritis.

On behalf of DR. A. E. PATERSON, DR. D. WATSON showed a boy, aged one year, who had been admitted to hospital on April 19, 1941, with generalized œdema and albuminuria. The history given was that his face had been swollen for five days and his abdomen and feet had also greatly swollen since. He had had "gastro-enteritis" two weeks previously, but no other illnesses.

On examination the child was flushed and irritable. The heart and lungs were normal; the throat was slightly inflamed; the abdomen was distended, and there appeared to be some dulness to percussion in the flanks. The face and legs were œdematous. A provisional diagnosis of acute nephritis was made. The child was given no food for thirty-six hours, and during that time fluid intake was restricted to one and a half pints in twenty-four hours; he was then given a light carbohydrate diet. At the end of five days no improvement had occurred; the legs had become more swollen, but the face did not seem so puffy as before; the arms were now swollen. The child was passing only small amounts of urine into the bed, so no specimen had been tested.

The child was now given treatment as suggested by Davidson, Dunlop and McNee in "Textbook of Medical Treatment". This consisted of one and a half ounces of 30% glucose in water with fruit juices, alternating every two hours with one and a half ounces of milk for eight feedings. That afternoon one ounce of urine was collected; on testing, it was solid with albumin and contained much blood. That evening the temperature rose to 102·6° F.; no cause could be found, but the child was given "M & B 693" tablets. The next day, April 25, the temperature was normal; the child's face and arms seemed less swollen, but the feet remained the same.

By April 30, 1941, the œdema had subsided a little, but the child was still only passing urine in small amounts, one to four ounces per day. He was given a high fluid diet in the hope of producing a diuresis, which was to be expected by that time; the diet consisted of three ounces of glucose in fruit juice every two hours for sixteen hours, with one slice of bread and butter and marmalade, given only three times. The diet was then three ounces of fruit juice in 30% glucose solution. Next day this alternated with three ounces of milk and bread and butter and marmalade given three times. On May 5, 1941, it was noted that the œdema was generally less, but there was still a considerable amount in the feet; the child was much brighter. It was considered that the condition was probably becoming subacute, so the diet was increased to half an ounce of meat or three-quarters of an ounce of fish, one-quarter of a pint of milk, one and a half ounces of bread, as a daily ration, supplemented by butter, marmalade, vegetables (except peas or beans), potato, cereal pudding and fruit. On May 8, 1941, it was thought that the child was not doing well on the increased diet and he was put back to the previous one. The Wassermann test had produced no reaction. Three blood counts had been made; the number of erythrocytes varied between 3,900,000 and 4,300,000 per cubic millimetre, the hæmoglobin value between 75% and 80%, and the leucocytes between 9,800 and 18,300 per cubic millimetre. The urine tests revealed a few pus cells and eyrthrocytes and a number of casts, hyaline and granular. A blood cholesterol test made on May 14, 1941, gave the figure of 170 milligrammes per 100 cubic centimetres of blood. The systolic blood pressure was 105 milligrammes of mercury and the diastolic pressure 75. The condition was one of acute nephritis which had now become subacute.

MEDICO-POLITICAL.

A MEETING of the Victorian Branch of the British Medical Association was held at the Medical Society Hall, Albert Street, East Melbourne, on February 4, 1942, DR. H. BOYD GRAHAM, D.S.O., M.C., the President, in the chair.

Statement of Receipts and Expenditure.

DR. C. H. MOLLISON, the Honorary Treasurer, presented the statement of receipts and expenditure of the Victorian Branch of the British Medical Association and of the Medical Society of Victoria for the year ended December 31, 1941. In presenting the statement Dr. Mollison spoke in the following terms.

I have pleasure in presenting the statement of receipts and expenditure of the British Medical Association (Victorian Branch) and the Medical Society of Victoria for the year ended December 31, 1941.

This year I am pleased to report a substantial credit balance—£1,345 14s.—an increase over the previous year of £919 5s. 4d., which is a matter for congratulation.

The amount received for subscriptions during 1941, you will observe, was £7,754 4s. 9d., as against £7,393 19s. 1d. in 1940, an increase of £360 5s. 8d.

Expenditure, on the other hand, increased by approximately £320.

Items in which there were decreases were salaries, £73 0s. 1d., caused by Mr. Ward being seconded to the Defence Department in 1939; rebates to subdivisions, £21 14s.; £155 13s. 6d. in capitation fees to the Federal Council. (The expenditure under capitation fees in 1940 included arrears of £286 in respect of the year 1939. The amount for fees due to the Federal Council for the respective years were therefore £295 12s. 6d. in 1940 and £425 19s. in 1941, an increase of £130 6s. 6d.) Travelling expenses were decreased by £14 2s. 4d., entertainments by £12 17s. 8d., repairs and alterations by £6 15s. 6d., and there were minor savings in other items.

As against these savings, an increased amount of £178 3s. 3d. was paid to *The British Medical Journal*, and increased expenditure was incurred under the following headings: stationery, £14 1s. 8d.; printing, £56 17s. 10d. (mainly due to the reprinting of the rules); library books *et cetera*, £41 5s. 9d. (including £32 for cleaning and spraying books); legal expenses, £25 8s. 6d. (£27 was paid for counsel's opinions *et cetera re* practitioners' rights in workers' compensation cases); electric light and heating, £40 9s. 6d. (due to the use of electric radiators over a longer period than usual and to additional use of radiators for the work of the State Medical Coordination Committee, for which an amount of £12 was received from the Department of the Army as an offset to portion of the increase shown above); bonuses for the years 1940 and 1941 to the Medical Secretary and the Financial Secretary amounted to £300; donations, £47 1s., including £25 to the Medical War Relief Fund and £21 to the "*Sydney* Replacement Fund".

I have placed the expenditure under the different items for the respective years in juxtaposition, so that if any member desires details, I am in a position to furnish them.

	1940.	1941.
The British Medical Journal	£1,820 14 0	£1,998 17 3
Rebates	74 18 6	53 4 6
Federal Council capitation fees	581 12 6	425 19 0
Salaries	1,833 11 10	1,760 11 9
Mr. Crouch	300 0 0	300 0 0
Postages	158 19 6	159 10 8
Stationery	78 0 9	92 2 5
Printing	15 9 3	72 7 1
Sundries	103 4 1	106 2 2
Audit	15 15 0	15 15 0
Bank charges	8 9 11	4 11 8
Telephones	71 2 5	69 16 1
Travelling expenses	21 3 2	7 0 10
THE MEDICAL JOURNAL OF AUSTRALIA	1,360 7 6	1,345 10 0
Library books *et cetera* (including cleaning books)	130 12 0	171 17 9
Rates, taxes, insurance	45 19 6	43 11 10
Legal expenses	5 5 0	30 13 6
Electricity and heating	49 9 2	89 18 8
Entertainment	20 0 4	7 2 8
Donations	—	47 1 0
Repairs and alterations	12 11 6	5 16 0
Office equipment	98 0 0	21 5 0
Debenture interest	237 5 0	230 8 8
Bonuses to Medical Secretary and Financial Secretary, two years, 1940-1941	—	300 0 0
	£7,042 10 11	£7,359 3 6

Members may rest assured that strict vigilance is being kept over all expenditure. This is necessary owing to the uncertainty of the future. Members' subscriptions, for instance, may show a considerable decrease owing to the concession your Council was pleased to make to members relinquishing private practice to serve in the forces. The subscription to those members has been decreased to £1 11s. 6d. *per annum*, a reduction which may considerably reduce subscription revenue in the future.

The Association is again greatly indebted to the insurance company. In addition to providing £480 towards the Medical Secretary's salary, its action in voluntarily agreeing to a reduction in the interest rate on its debenture holding from 5% to 1% represents a substantial saving to the Society. Furthermore, the company purchased books for the library to the value of £58 1s. 8d. I trust members will show their appreciation for the assistance given by the insurance company by placing as much of their insurance with it as they can possibly arrange. Members should bear in mind that this company is theirs and that its profits will accrue to their good. The company is an asset which members should take particular care to conserve and enhance.

The amount contributed to the Medical Benevolent Fund, £176 19s. 9d., is 6s. 9d. less than the previous year. I would particularly draw members' attention to this fund. It is one that should need no recommendation from me. Its sole purpose is to relieve distressed members. Unfortunately its activities have to be restricted to the degree to which members contribute to the fund.

I have pleasure in submitting for adoption the statement of receipts and expenditure.

The financial statement, which was adopted, is published herewith.

BRITISH MEDICAL ASSOCIATION (VICTORIAN BRANCH) AND THE MEDICAL SOTIETY OF VICTORIA.

Combined Statement of Receipts and Expenditure for Year ended December 31, 1941.

RECEIPTS.	£ s. d.	£ s. d.
To National Bank of Australasia, Limited—		
Medical Society of Victoria, Cr.	582 15 10	
Less British Medical Association, Dr.	156 7 2	
		426 8 8
„ Cash in Hand, January 1, 1941		12 0 0
„ Subscriptions		7,754 4 9
„ Medical Benevolent Fund		176 19 9
„ British Medical Insurance Company—Grant		480 0 0
„ Rent of Hall		15 12 8
„ Sale of Journals		3 11 5
„ Medical War Relief Fund—		
Donations by Members	1,734 19 6	
Donations by Medical Society of Victoria	25 0 0	
	1,759 19 6	
Less Expenses, Postage *et cetera*	2 16 6	
		1,757 3 0
		£10,626 0 3

EXPENDITURE.	£ s. d.	£ s. d.
By British Medical Association		1,998 17 3
„ THE MEDICAL JOURNAL OF AUSTRALIA		1,345 10 0
„ Medical Benevolent Fund		176 19 9
„ Federal Council of the British Medical Association in Australia—Capitation Fees		425 19 0
„ Rebates to Subdivisions		53 4 6
„ Library Books and Journals *et cetera*	229 19 5	
Less Contribution from British Medical Insurance Company	58 1 8	
		171 17 9
„ Salaries—		
Medical Secretary	900 0 0	
Office and Library *et cetera*	860 11 9	
		1,760 11 9
„ Pension—C. S. Crouch		300 0 0
„ Debenture Interest		230 8 8
„ Audit Fees		15 15 0
„ Postages		159 10 8
„ Printing and Stationery		164 9 6
„ Sundry Expenses		103 12 2
„ Bank Charges		4 11 8
„ Telephones		69 16 1
„ Lighting and Heating		89 18 8
„ Rates, Taxes and Insurance		43 11 10
„ Repairs		5 16 0
„ Office Equipment		21 5 0
„ Travelling Expenses		7 0 10
„ Legal Expenses		30 13 6
„ Entertainment		7 2 8
„ Lanternist		2 10 0
„ Donations		22 1 0
„ Bonuses to Medical Secretary and Financial Secretary (1940 and 1941)		300 0 0
„ Medical War Relief Fund (amount remitted to Federal Council)		1,757 3 0
„ Cash in Hand, December 31, 1941		12 0 0
„ National Bank of Australasia, Limited—		
Medical Society of Victoria	1,283 15 10	
British Medical Association	61 18 2	
		1,345 14 0
		£10,626 0 3

C. H. DICKSON, Secretary.
C. H. MOLLISON, Honorary Treasurer.

Compared with the books and accounts of the British Medical Association (Victorian Branch) and the Medical Society of Victoria and found to be in accordance therewith.

Melbourne, 27th day of January, 1942.

J. V. M. WOOD & COMPANY,
Chartered Accountants (Aust.).

VICTORIAN BRANCH NEWS.

THE following letter from the Premier's Department, Victoria, is published at the request of the Council of the Victorian Branch for the information of members.

Melbourne,
6th February, 1942.

Dear Sir,

In continuation of prior correspondence on the subject of medical services in remote areas of the State, the Premier has been informed by the Acting Secretary of the Shire of Minhamite, Hawkesdale, that the Council is anxious to secure a resident doctor for Macarthur. The doctor appointed would hold the position of Medical Officer of Health for the Shire.

Mr. Dunstan would be glad if this opening could be brought to the notice of members of the Association through its journal.

Yours faithfully,
(Signed) .....,
For Secretary.

The Medical Secretary,
Victorian Branch,
British Medical Association,
426 Albert Street,
East Melbourne, C.2.

Medical Societies.

THE AUSTRALIAN ORTHOPÆDIC ASSOCIATION.

THE annual meeting of the Australian Orthopædic Association was held in October, 1941, at Melbourne, DR. ARTHUR V. MEEHAN, the President, in the chair.

Original Articles.

Among the papers read were the following: "Sciatica: Its Causes and Treatment", by A. Juett; "Fractures of the Radius and Ulna", by H. A. Sweetapple; "The Treatment of Gas Gangrene", by W. Hugh Smith. These were published in the issue of January 24, 1942.

Spastic Paralysis.

DR. JEAN MACNAMARA discussed spastic paralysis and showed four patients. She said that the epidemic of poliomyelitis that occurred in Victoria in 1937 had had one good result: patients with minor degrees of crippling were being recognized and treated earlier. Among such patients were the spastic children. Dr. Macnamara had not attempted to classify spastic paralysis according to the localization of

brain injury or failure of development; but it was helpful to classify these patients into three groups: (i) children whose antenatal development had been normal, but who had suffered trauma during the process of birth; (ii) those handicapped by some interference in antenatal life—premature children, twins and those whose mothers had had toxæmia, sickness, kidney disease, operation or injury during pregnancy; (iii) children normal at birth and growing normally until affected by an illness in early life; many of these had hemiplegia. This classification did not run parallel with the different clinical forms of spastic paralysis. True spastic paralysis or athetoid spasm might follow any of the clinical histories mentioned earlier.

Dr. Macnamara said that she had nothing spectacular to contribute to the problem of treatment of spastic paralysis, no short cut to normal movement to raise hopes as their hopes had been raised twenty years earlier by the work of Hunter and Royle. Nevertheless she felt that orthopædic surgeons should be the leaders in the eradication of an attitude still prevalent among doctors, that there was little to be done to help the spastic child. That attitude naturally followed the reading of descriptions in text-books, in which the illustrations and text conveyed the idea that the deformities pictured were essential features of the condition. The deformities of adducted and internally rotated thighs, plantar-flexed feet, and often flexed knees and hips, adducted shoulders, pronated forearms, flexed wrists and fingers and adducted thumbs were described as an integral part of the picture of spastic paralysis. Her experience had led her to regard these deformities not as an integral part, but rather as sequelæ which followed the original condition, whether it were trauma, failure of development or infection. These sequelæ became more pronounced as the years went by, not because of the spastic condition, but because of positions habitually assumed. By the time the parents had realized that the baby's development was not normal it was too late to do anything about the actual cause of the trouble. The unfavourable condition in antenatal life, the mechanical struggle during birth or the infection were over and done with and were not the concern of orthopædic surgeons. Dr. Macnamara thought that in many cases they could guide the child to a better future by saving it the extra handicap added by deformity. That, briefly, was the answer to the first of Lovett's famous questions: "What are you trying to do?" She then considered his second question: "Is it worth doing?" Dr. Macnamara admitted that in a small proportion of cases it did not seem worth the trouble. However, as the number of mild lesions and of younger children seeking treatment increased, so the proportion of discouraging cases was reduced. A history of repeated convulsions was discouraging, nor did they welcome as promising material the child whose attention wandered quickly. In a few cases the degenerative process appeared to be continuous or to return from time to time, as after encephalitis; but the three groups—the epileptic, the "flitter" and the child with a progressive lesion—formed a very small proportion of the group labelled "spastic". It seemed that the experience of the men who wrote the chapters on spastic paralysis in the text-books for students must have been drawn mainly from these groups, their pictures were so gloomy.

Dr. Macnamara went on to discuss intelligence. She said that the mental ability of normal people was judged by actions of the muscles of the hands and of the muscles involved in speech. What they said and what they did with their hands provided the standards by which their intelligence was measured. In trying to estimate the intelligence of a spastic child one had in fairness to take into consideration the handicap he suffered in communicating his thoughts by means of muscle actions evolved with great difficulty. At the Children's Hospital, Melbourne, they had been fortunate in having an active psychiatric clinic under the direction of Dr. John Williams. In this clinic a patient, trained worker, Miss Drake, spent hours in testing to assess how much intelligence lay behind the hesitant speech. Dr. Williams had said of one boy: "It takes twenty minutes to understand what Maurice is trying to tell you; but what he does say is more worth one's attention than the easy talk of most other people." In the past year they had learnt that even the two or three hours spent by Miss Drake might not be enough to judge the child fairly. One year earlier a class for spastic children was started at the Children's Hospital. A condition of the grant that made possible its establishment was that the children should be intelligent. Each applicant was referred to Dr. Williams's clinic for assessment. One country child hardly measured up to the standard; but he was given the benefit of the doubt and allowed a few weeks on approval at the class. It was found that when fear and shyness had been overcome, he could do easily tests impossible at the first interview. One was rarely justified in labelling a spastic child mentally defective unless hours had been spent in observation and tests. In order to prevent unfair labelling of intelligent spastic children as mentally defective, the aim was to discover such children when they were young enough to allow for a term at the class before school age. The answer to Lovett's second question, "Is it worth doing?"—the attempt to save the child further handicap from deformity—might be in the negative for a small minority (the epileptics and those with the progressive type of lesion); but for the majority it had been found worth the trouble.

Dr. Macnamara then considered Lovett's third question, "Are we doing it?" With regard to the possibility of saving the child the overburden of deformity, she said that they had found the pull of the adductors of the thighs to the scissor position the easiest to anticipate. The contraction of the flexors of the wrists and fingers had yielded easily. The tendency to pronation was not difficult to anticipate, but was fairly hard to correct. The adduction of the thumb and the tendency to equinus had given most trouble. By constantly blocking the adductor pull of the thighs in sitting, lying and standing, the balance between the abductors and adductors could be easily kept if splinting was commenced when the child was young. For little children blocking by means of a wedge of wood was tolerated better than the use of a frame, and was less expensive. When the rate of growth was slower, a splint of the double Thomas type was simpler, and outward rotation as well as abduction could be attained. Splints of Cramer wire had been found useful for the correction of pronation. In one instance they had kept up this splinting too long and were now trying to discourage the supinators. It was well to see the patient at regular intervals, to adjust the splints for growth and to keep the balance at the optimum. Each mother was taught to keep the child consistently in splints during sleep and while she was busy with housework, and how to remove the splints and encourage the special movement required whenever she had a few minutes of leisure. The mothers of spastic children deserved the highest tribute for patience and courage. In conclusion Dr. Macnamara said that a simple simile had helped some to appreciate the child's difficulties. The idea of a "party line" of the telephone in a country district was used: someone rang up "Irriwillippi 290 J", for example, and the receivers of A, B, C, D *et cetera* came off the hook. In the same way the messages to a certain muscle group spilled over to other muscles for which they were not intended. Time did not permit any discussion of the place of operative orthopædics in the care of the spastic. Most operations were devised to correct the over-action of certain muscle groups. If such children were recognized early and cared for early and consistently, it had been found that the tendency to over-action of these groups was considerably lessened in most instances and in others did not occur.

Paralysis of Limbs.

Dr. Macnamara also showed several patients suffering from limb paralysis, in order to demonstrate a splint already described in this journal for the protection of and for making some use of flail or nearly flail arms (see THE MEDICAL JOURNAL OF AUSTRALIA, Volume II, September 6, 1941, page 276). The first patient, a boy, aged seventeen years, had a right hemiplegia following a difficult birth. He came for treatment in February, 1937, at the age of twelve years and nine months, at his own request. The right arm was useless to him, the wrist being flexed, the fingers contracted in flexion and the forearm pronated. The right heel did not touch the ground. The left foot was everted. A hand splint was worn continually for two years to stretch gradually the contracted flexors of the fingers and of the wrist. The position was modified as the contraction yielded to give some dorsiflexion of the wrist. When it was possible to dorsiflex the wrist with extended fingers the adduction of the thumb was tackled. From the beginning of treatment the patient had worn at night, in addition to the hand splint, a splint to correct the pronation of the forearm. At the time of the meeting the two were incorporated in one splint. The right calf had in twelve months been stretched enough to enable the patient to walk on his heel. He had worn night splints to give dorsiflexion of the right foot and inversion of the left. In two years active dorsiflexion of the wrist and fingers had returned and he now had a useful amount of active supination. Dr. Macnamara said that he was shown to demonstrate the long patient process necessary to correct deformities that should never have been allowed to develop.

The second patient was shown to demonstrate the wedge or triangle made of two pieces of wood joined at their distal ends by a sliding bar, such as that used on casement windows. Dr. Macnamara said that these triangles were useful for little children to prevent contraction of the adductors and hamstrings. Contraction of the *tendo Achillis* was prevented by the pull of the spring, coiled to hold the foot at a right angle.

The third patient, a female, aged seventeen years, had been referred in 1938 to the Victorian Society for Crippled Children for training for a position suitable for a single-handed child; her right hand was regarded as useless because of contractions following hemiplegia, noticed soon after birth. She had gradually corrected the contractions. Active dorsiflexion of the wrist and fingers had returned, together with a useful amount of abduction of the thumb. She was now using both hands throughout the day as a telephone operator.

The fourth patient, a boy, aged six years, was shown for two reasons. He had a severe left hemiplegia following a difficult instrumental birth. As usual, the left forearm was contracted in pronation. Gradually this was corrected, and now the supinators were the stronger group; so that the splint he was now wearing at night gave pronation. His habit of dribbling had been corrected by his mother. On being told that it had been suggested that the giving of sips of fluid occasionally would help to cure the habit, she went further and gave him no fluid at all except in sips; his swallowing reflex was conditioned to come into action at the stimulus of a tiny amount of fluid, and it therefore acted when saliva came into the mouth.

Facial Paralysis.

Dr. Macnamara also showed one patient who had had facial paralysis. He was shown in order to demonstrate three splints found useful: one of vulcanite to retract the angle of the mouth and to hold the upper lip up and rolled out and the lower lip down and rolled out. This splint had been devised by Dr. Kenneth Russell in Melbourne in 1927. Another splint of rubber was useful when the *orbicularis oris* muscles were those most needing help, and the third when the triangular depressor of the lower lip was the last to recover.

Pain Related to the Medial Malleolus.

DR. A. R. HAMILTON reported a series of four cases of pain and tenderness below and just behind the medial malleolus, and in which treatment had consisted simply in incision of the dense portion of the sheath of the *tibialis posticus* tendon just behind the malleolus.

The first patient had bilateral *pes planus*, and as a result of a severe sprain he suffered from persistent pain and tenderness beneath the medial malleolus in his right foot for four years; the foot was held in the equino-valgus position. At operation the portion of *tibialis posticus* tendon distal to the dense portion of its sheath was greatly thickened, lustreless and yellowish, with enlarged arterioles on its surface, whilst the tendon in the dense sheath was normal in appearance. After incision the pain and equinus disappeared; but the patient had a rigid flat foot, which in itself caused little trouble. He ultimately returned to work after four years' incapacity.

The second patient was a young man who strained his ankle and was discharged from the Army on account of equino-varus spasm and pain about the medial malleolus. This had been present for a few months. At operation the sheath was incised and a small nodular thickening was detected in the *tibialis posticus* tendon. He made a rapid and complete recovery and recommenced military training.

The third patient was also a young man, who four months previously had severely jarred his foot and began to suffer from pain beneath the medial malleolus and at the base of his fifth metatarsal bone. The former prevented him from working; the sheath of the *tibialis posticus* tendon was incised and beyond a few adhesions no other abnormality was detected. The pain disappeared from the medial malleolus, and when he was last seen the patient believed he would be able to resume work.

The fourth patient was an elderly female, who had pain and a cystic swelling beneath and in front of the medial malleolus. At operation the sheath of the *tibialis posticus* distal to the dense portion was greatly thickened and distended with fluid. The thick wall was removed and the tendon was found to be thickened, red and covered with dense adhesions. The margin of the dense portion of the sheath was pouting and congested; this dense portion was incised and normal tendon was exposed. Dr. Hamilton remarked that it was too early to assess the value of operation in this case; but recent examination revealed satisfactory progress. Some local post-operative œdema and soreness were still present.

Dr. Hamilton commented that the lesion constituted a clinical entity analogous to *tenovaginitis stenosans* at the radial styloid, but as far as he knew hitherto not described.

The points of interest were: (i) the traumatic origin, (ii) chronicity of the symptoms, (iii) the localized pain and tenderness, (iv) the rapid relief afforded by a simple operative procedure.

Repair of Flexor Tendons of the Fingers.

DR. THOMAS KING showed three patients to illustrate the results of secondary repair of flexor tendons within the osteo-fascial canals of the fingers. The first patient, a manual labourer, had been working for five years since the repair, and he had virtually normal function of the ring, middle and fifth fingers. Those three fingers were operated on seven months after the injury; but at the time of the accident immediate repair had been attempted in a casualty department and suppurative teno-synovitis resulted.

The second patient was a child, who had been operated upon two years earlier for a severed *flexor pollicis longus* tendon of two months' duration; the tendon had been severed within the tendon sheath in the distal part of the thenar eminence. Dr. King said that the injury had the same serious prognosis as that of severed finger tendons. As the thecal sheath extended from the forearm to the base of the terminal phalanx, it was much longer than the sheaths for the fingers, although the osteo-fascial canal began only at the base of the proximal phalanx. On the other hand, the sheath was occupied by one tendon only. The tendon had been divided over the centre of the metacarpal bone; but by the time healthy tendon was recovered in the distal end the repair operation was carried out in the osteo-fascial canal. Almost normal function was present. A special feature of the operation was a dissection to preserve the important muscular branch of the median nerve to the thenar muscles.

The third patient had been operated on four months earlier. Five months earlier still she had had traumatic septic teno-vaginitis caused by a wound over the proximal phalanx of the middle finger, which had severed the profundus and sublimis tendons. Dr. King remarked that a considerable amount of movement was still lacking, but improvement had been progressive. The important point was that the tendon was acting on the terminal phalanx and the intervening joints all moved with contraction of the profundus muscle. The interphalangeal joints had been fairly stiff before the operation, despite a considerable amount of pre-operative physical therapy. Dr. King said that lesions of that type were not suitable for tenoplasty; but the present function was useful, and the condition was better than that which would have followed amputation. For the next two years improvement could be expected; exercise and movement gradually loosened many adhesions.

Dr. King went on to say that the first two patients illustrated nearly perfect results and showed that good results were possible. Some might regard them as providing the exceptions to the rule that all tendon repairs in the osteo-fascial canal were doomed to failure; but Dr. King regarded them as providing the exceptions that disproved that rule. T. B. Mouat, writing in the section on wounds of tendons, in Part III of "Surgery of Modern Warfare", had quoted Lennox Teece, of Sydney, who had stated that after an experience covering the examination of hundreds of such injuries he had never seen a successful result. The problem of the successful repair of those tendons had always appeared to Dr. King to be soluble, even when his efforts were vain during the first few operations and he heard of failures on all sides, except in the writings of Bunnell, Iselin and others. Steindler in his book had claimed good results in fifteen cases of repair of finger tendons. Notwithstanding the claims of these authors, H. B. Yates had started a correspondence in recent numbers of *The British Medical Journal*, in which various writers testified that they had never seen a successful result follow suture by any known method of digital flexor tendons. In a second letter, under the heading "Cut Tendons: An Appeal", Yates had made the following remarks: "May I ask one pertinent question. Is there is a single surgeon in the land—general or orthopædic—resident medical officer—past or present—who has succeeded in establishing a return of movement in the interphalangeal joints after any method . . .? If no such success has been obtained, is it not our duty to advise and carry out primary amputation . . .?" One letter appeared in answer to Yates, in which several good results were claimed.

Dr. King then discussed the treatment of patients with severed flexor tendons. He said that primary suture of severed flexor tendons in their osteo-fibrous canals was performed only under ideal conditions—for example, less than about four hours after the wound had been made by clean glass. The operation should not be performed by inexperienced casualty surgeons, who should merely excise the wound, splint the finger and hand in a plaster cast and see that the patient was admitted to hospital immediately for secondary repair at a later date. Secondary repair was carried out some weeks later, when the clinical test of irritation of the wound by massage and heat was followed by no local or general inflammatory reactions. If infection

occurred in the wound, six to twelve weeks should be allowed to elapse after it had soundly healed. Operation was performed under general anæsthesia. A pneumatic tourniquet was used, and only one finger should be dealt with at any operation; if three fingers were involved, they should be operated on at intervals of one month. No special instruments were used except eye instruments. At operation a lateral incision was made through the skin and tendon sheath; injury to digital vessels and nerves was avoided. The distal end of the tendon was freed until normal tendon was seen. If the proximal end could not be found by dissection, especially by Hilton's method, then an incision was made in the wrist proximal to the transverse carpal ligament and the tendons were hooked up. Dr. King said that the method could not fail, because a pull on the tendons of the unaffected fingers resulted in movement of those fingers, but a pull on the tendon of the affected finger or fingers caused a dimpling in the palm over the course of the tendon towards the appropriate fingers, or else the tendon was pulled up in the wrist incision. A piece of silk passed through the proximal end and attached to a probe permitted the proximal end to be approximated towards the distal end. A gap of at least one inch now remained. In no circumstances should the sublimis tendon be repaired. If it was intact, the slips into the sides of the first phalanx should be divided and the stumps trimmed. There was no room in the finger for two repaired tendons. The tendon was then hooked out through the wrist wound and shortened and attached to the profundus tendon at the wrist or in the palm. The piece of the sublimis tendon that was left over could be used to make a pulley or loop on the front of the first phalanx to prevent herniation of the tendon.

Dr. King went on to say that to lengthen the tendon a vertical incision was made proximal to the transverse carpal ligament; this allowed a "Z sliding" lengthening of the tendon in a place where no peritendinous adhesions were likely to follow. A lengthening of two inches was thus obtained. Recently a transverse division of the tendon at the junction of the distal third and proximal two-thirds of the profundus muscle belly had been recommended by L. Blum in *Annals of Surgery*, March, 1941, at page 460; about half an inch of lengthening was obtained and a gap appeared in the unipennate muscle.

With regard to suture of the wound, Dr. King said that although the distal and proximal ends could now easily be drawn so tightly together that they folded up like a concertina or a bellows, which was strongly advised by Bunnell, the suturing of the skin was not easy. It was fatal to repair the osteo-fibrous canal. A piece of the sublimis tendon that had been left over, as described earlier, could be sewn on either side of the first phalanx to fibrous tissue about the middle of the shaft; but it had to fit very loosely round the profundus tendon, otherwise it might cause adhesions. Dr. King remarked that it was obvious that the loop must not be situated where it would impinge on the repaired area of the tendon when it moved. The skin wound should only be sutured, and this could be carried out only when the finger was flexed. The skin suturing took nearly as long as all the work that had been done before; it had to be done carefully with fine curved needles and either waxed silk or fine dermal suture.

With regard to splinting, Dr. King said that it was essential that the fingers should be fully flexed onto the palm. A sterile pad was placed in the palm and the hand was bound to it by crêpe bandages. Slight finger movements were encouraged as soon as the patient recovered from the anæsthetic, and from then onwards as much as possible and as often. Dr. King remarked that those surgeons who strongly condemned early movements were invariably those who said that they had never seen or had a successful result. He thought that they should try the effect of early active movement. Unless early active movements were insisted on, peritendinous adhesions were certain to form; that meant absolute failure of the operation. If early movements were likely to tear apart the repaired tendon ends, then that risk had to be taken; but Dr. King did not believe it was a serious possibility. Failure was caused by infection of the wound, sloughing of the skin, bad selection of patients for operation (for example, those with stiff or ankylosed interphalangeal joints), by bad tendon suturing so that the ends tore apart with early movements, by removal of skin sutures before two or three weeks, and by failure to carry out early active movements. At the end of three weeks the repaired tendon should be strong enough to withstand the important "uncurling" of the flexed fingers by flat rubber bands attached to a dorsal splint, to stretch the fingers. As the fully flexed fingers were gradually unfolded from the clenched palm position peritendinous adhesions were stretched, because the lengthening of the shortened tendon by that means pulled out the adhesions also.

Brodie's Abscesses at the Lower End of the Femur Treated Conservatively and by Operation.

Dr. King explained that when Brodie's abscess was in one or other of the femoral condyles and close to the articular surfaces, the surgical approach was difficult if infection of the knee joint was to be avoided. In the last year he had seen six patients each with a chronic effusion in the knee joint caused by Brodie's abscess of the adjacent bone. All were treated in the first place by a weight-relieving caliper in order to take the strain of weight bearing from the inflamed bone, articular cartilage and synovial membrane. Thereby Dr. King hoped that cure might result. One of the patients shown at the meeting, aged twenty years, had progressively improved, as shown by subsidence of swelling and effusion and serial skiagrams, and appeared to be cured by this conservative method.

DR. L. O. BETTS commented that the wall of the abscess was not sclerotic and consequently this abscess was amenable to conservative treatment.

Dr. King said that the other patient, aged forty-nine years, had been operated upon, the incision being made well above the subcrural pouch. A tube was placed in an opening of the femoral shaft and down into the abscess, the situation of which should be verified by a probe and control X-ray examination at the time of operation. The wall of the abscess was sclerosed, unlike that in the first patient, and despite drainage for a few weeks the knee joint effusion recurred later. Deep X-ray therapy appeared to have caused improvement in the swelling. Dr. Betts had pointed out that deep X rays might unfavourably affect the articular cartilage and subchondral bone as well as other joint structures, causing aseptic necrosis of bone and stiffness of the joint. But in this patient the risk of such stiffness arising from X-ray therapy did not seem so important a factor as the stiffness and disability resulting from a chronic effusion causing softening of the joint structures and the danger of septic arthritis.

Recurrent Dislocation of Shoulder.

Dr. King showed two patients operated on by Nikola's method for recurrent dislocation of the shoulder. The operation had been supplemented by lengthening the coracoid process, the operation so strongly recommended by surgeons in France, where it appeared to be the standard method and was described in students' text-books. Oudard's method of lengthening the coracoid process by sliding the obliquely divided process had been modified by Louis Avril (*thèse de Paris*) and others, who used a bone graft let into a cleft made by splitting the coracoid from tip to base (described in *"L'Epaule"*, by Basset and Mialaret).

The advantages of this operation were: (i) Redislocation forward seemed impossible. (ii) It was extraarticular, which was an advantage should infection occur (this did not apply, of course, if Nikola's operation was also performed). (iii) The operation was easy to perform.

The disadvantages were: (i) A bone graft was obtained from the tibia which was weakened and a fracture might occur later. (ii) The graft might fail to unite to the coracoid process. (iii) Some slight limitation (about 5% to 10%) of abduction appeared likely in most cases because the two muscles attached to the coracoid (short head of biceps and coracobrachialis) now had their origin about two inches lower (distal).

One of the patients shown had been operated upon five years previously and now complained of slight limitation of abduction and occasionally of pain in the tibia from where the graft was removed, but no redislocation had occurred even with rowing. The other patient had been operated upon twice in the last seven years at the University Orthopædic Clinic in Berlin, and *fascia lata* slings were used, but failed. Dr. King said that after such failures he wished to ensure success by supplementing the excellent Nikola's operation with the added security of the prolongation of the coracoid process for one and a half to two inches beyond the tip of the coracoid in a downward direction. A piece of bone three inches by half an inch was removed from the tibial crest and the tip of the coracoid process was then exposed in the upper end of the delto-pectoral groove. The conjoined tendon of the coraco-brachialis and short head of the biceps was split lengthwise for about three inches up to the attachment of the coracoid tip. The coracoid was split from tip to base. The graft was inserted into the opening and into the split conjoined tendon. About three silk sutures closed over the splint tendon and thereby fixed the graft securely. The arm was placed on an abduction splint for six weeks, but might be fixed by the side for the same time, depending on the circumstances.

Tuberculosis of the Ankle Joint.

Dr. King finally showed a youth, aged twenty years, who suffered from tuberculosis of the ankle joint and had been treated for two years conservatively, by recumbency in a crab splint extending to the groin, and by exposure to graduated heliotherapy. The joint had steadily deteriorated. Serial X-ray examination revealed only a very slow erosion of the articular surface, but the soft tissues had become very swollen (the typical pale puffy joint of tuberculous disease). It was known that in most patients with tuberculous arthritis of the ankle the disease was not eradicable by excision of the joint, because the skin was affected, the blood supply was poor and sound healing would be further prejudiced by the operation. Consequently, as an alternative to amputation, Dr. King had begun some two years previously to drive subcutaneously two long half-inch thick bone pegs across the ankle joint. The pegs were cut from the tibia on the affected side. This method was strongly recommended by French surgeons. The subastragaloid joint should also be impaled. The simplest way to drive the pegs in was through the *os calcis* and passing vertically through the talus from the fibular and tibial malleoli. The skin incisions should be just large enough to allow the graft to be driven in along the drill holes, about half-inch incisions being made; otherwise sound skin healing might not occur. This boy showed excellent improvement. Dr. King explained that it was only one year since the operation and bony ankylosis had taken place in parts especially in the vicinity of the bone grafts. Dr. Glissan also had had successes with this method. Dr. King believed that it should have an important place in the treatment of tuberculous arthritis of the ankle joint, especially when amputation was contemplated. Dr. Glissan, he thought, held that the good effect of the operation was the absolute immobilization, but another factor was the favourable inflammatory reaction supplied by the slight operation and the effect of fresh undiseased bone in the midst of the tuberculous disease. Naturally some failures were to be expected.

National Emergency Measures.

MEDICAL EQUIPMENT.

THE Medical Equipment Control Committee desires to direct the attention of all members of the medical profession to the following information.

The Use of Australian Drugs.

The Emergency Formulary of Australia was introduced in May, 1941, with a triple objective: to indicate such Australian-made drugs as are available; to stimulate prescribers to make full use of these drugs; and to facilitate this by presenting them in a therapeutic index with suggestive formulæ to indicate their range of application.

The addition of such drugs as belladonna and its official preparations, chlorbutol, chloroform, hyoscine, proflavine, tincture of opium and others, to the list of Australian manufactures, has prompted the issue of an addendum. Besides increasing the therapeutic scope of the original formulary, this will also serve to redirect attention to the urgent need for thoughtful and economic prescribing.

Despite the availability of these Australian-made drugs, and the simple but effective prescribing suggestions offered, many practitioners are still adopting the easy but nationally inefficient method of prescribing these same drugs in proprietary forms, many of which are imported. Particularly does this apply to "tonics", analgesics, antacids, expectorants and hæmatinics, which comprise such a large volume of everyday prescribing and which are amply catered for in the "E.F.A."

If any formula quoted does not meet your exact therapeutic needs, use it as a basis for addition or other modification.

In the present state of emergency the simplest prescribing compatible with therapeutic efficiency must be the keynote. The need for economy has never been so urgent. Read again the "Economy List" of drugs published in THE MEDICAL JOURNAL OF AUSTRALIA (January 31, 1942, page 148).

Consider shipping space.

Save foreign exchange.

Study and use the formulæ and prescribing suggestions in the Emergency Formulary, that full use may be made of Australian drug resources.

Economy in the Use of Drugs in War-Time.

Owing to a clerical error, a note that Acaprin is manufactured in Australia was omitted from the list of drugs classified under various categories published in the issue of THE MEDICAL JOURNAL OF AUSTRALIA dated January 31, 1942, on page 148. This drug is now manufactured in this country as a result of research work undertaken by the Australian Association of Scientific Workers.

Correspondence.

HERPES RECURRENS.

SIR: The patient about whom I wrote you some eight years ago still suffers attacks of herpes on the same area. Some lesions have occurred on the adjacent cornea followed by obstinate ulceration and scarring. During the past two years they have not been so frequent—he is now aged thirteen years.

Any febrile illness or a holiday at the beach with exposure to strong sunlight tends to precipitate an attack. Occasionally he suffers a "P.U.O." followed twenty-four hours later by herpes.

I have found that the application of *Ung. Hydrarg. Ammon.* heals the lesions on the skin more quickly than anything else.

His tonsils have been removed, his teeth are sound, and at no time have I found any indications for removal of his appendix or drainage of his gall-bladder or sinuses or any other chronic septic focus.

For prevention I prescribe him well darkened glasses and a shady hat whilst at the beach (which he will wear under supervision—less supervision being required now that he is older and more careful) and frequent cold spongings to reduce his temperature during any feverishness. I have tried vaccinating him on several occasions with the exudate from his own lesions, but with no benefit.

He never has an attack without either previous exposure to strong sunlight or some pyrexia.

Yours, etc.,

H. R. P. BOUCAUT.

Mallala,
South Australia,
February 4, 1942.

Naval, Military and Air Force.

APPOINTMENTS.

THE undermentioned appointments, changes *et cetera* have been promulgated in the *Commonwealth of Australia Gazette*, Number 36, of February 5, 1942.

ROYAL AUSTRALIAN AIR FORCE.

Citizen Air Force: Medical Branch.

The following are appointed to commissions on probation with the rank of Flight Lieutenant with effect from the dates indicated: Donald Graham Hamilton, M.B., B.S., M.R.A.C.P., 22nd December, 1941; Reginald Ernest Ashbarry, M.B., B.S., Patrick Augustine Foley, M.B., B.S., 24th December, 1941; Felix Giovanni Favaloro, M.B., B.S., D.G.O., 26th December, 1941; Alastair Heriot Campbell, M.B., B.S., Roy Alan Julian Stanton, M.B., B.S., Trevor Harcourt Walker, M.B., B.S., 5th January, 1942.

The following Flight Lieutenants are transferred from the Reserve to the Active List with effect from 5th January, 1942: H. G. Andrew, F. J. Collett, J. M. Moyes, J. S. D. Sweeting.

The probationary appointments of the following Flight Lieutenants are confirmed: C. V. Newton, H. W. R. Sharp, A. K. McIntyre, S. MacK. Morson, A. E. Khan, R. L. Wilkinson, E. J. Andrews, G. B. Morris, D. A. Carter, J. H. Coto, J. V. Dale, L. L. O. Bevan, E. F. Langley, H. E. W. Lyons.

The probationary appointment of Pilot Officer C. W. Fitton is confirmed and he is promoted to Flying Officer with effect from 17th August, 1941.—(Ex. Min. No. 21—Approved 4th February, 1942.)

Reserve: Medical Branch.

The following are appointed to commissions on probation with the rank of Flight Lieutenant with effect from the dates indicated: Solomon Shineberg, M.B., Ch.M., 27th

December, 1941, Maurice Vivian Clarke, M.B., B.S., 30th December, 1941, Leo Charles Rowan, M.B., B.S., 31st December, 1941, John Richard Fountayne England, M.B., B.S., John Charles Lane, M.B., B.S., 5th January, 1942.—(Ex. Min. No. 20—Approved 4th February, 1942.)

CASUALTY.

ACCORDING to the casualty list received on February 17, 1942, Captain W. G. Holt, A.A.M.C., of King's Cross, New South Wales, previously reported missing believed prisoner, is now reported prisoner of war.

MEDICAL WAR RELIEF FUND.

THE following is a twenty-second list of contributions to the Medical War Relief Fund established by the Federal Council of the British Medical Association in Australia for the relief of distressed medical practitioners in Great Britain.

£52 10s.: Northern District Medical Association, "V" Anonymous.

£10 10s.: Western District Medical Association.

£3 3s.: Dr. S. G. Iceton, Dr. E. B. Fitzpatrick.

£2 2s.: Dr. M. C. McKinnon, Dr. Julia L. Amphlett, Dr. D. I. Low, Dr. S. R. Dawes, Dr. E. C. M. Wallace and Dr. Effie Seward (last two, joint contribution), Dr. H. G. D. Cookson.

£1 1s.: Dr. A. M. Aspinall, Dr. G. W. Sinclair, Dr. E. Kent Hughes, Dr. A. M. Purves, Dr. R. E. Longworth, Dr. A. E. H. Salter, Dr. A. L. Caselberg.

Australian Medical Board Proceedings.

TASMANIA.

THE undermentioned has been registered, pursuant to the provisions of the *Medical Act*, 1918, of Tasmania, as a duly qualified medical practitioner:

Trembath, John Douglas, M.B., B.S., 1941 (Univ. Melbourne), Launceston Public Hospital.

Obituary.

WILLIAM BOOKER VANCE.

WE regret to announce the death of Dr. William Booker Vance, which occurred on February 13, 1942, at St. Kilda, Victoria.

Nominations and Elections.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

McLaren, Kathleen Enid, M.B., B.S., 1933 (Univ. Sydney), Kendal Street, Cowra.

Rasmussen, Leonard, M.B., B.S., 1941 (Univ. Sydney), "Valhalla", Rectory Avenue, Ashfield.

The undermentioned have been elected members of the New South Wales Branch of the British Medical Association:

Allingham, Johnston Morton, M.B., B.S., 1941 (Univ. Sydney), St. George District Hospital, Kogarah.

Barry, Lorna Finlay, M.B., B.S., 1939 (Univ. Sydney), "Strathmore", Great North Road, Abbotsford.

Bartlett, Francis Kelvin, M.B., B.S., 1941 (Univ. Sydney), Royal North Shore Hospital, St. Leonards.

Begg, John Henry, M.B., B.S., 1941 (Univ. Sydney), Prince Henry Hospital, Little Bay.

Brand, Nugent Elliot, M.B., B.S., 1941 (Univ. Sydney), Royal Prince Alfred Hospital, Camperdown.

Busby, Hugh, M.B., B.S., 1941 (Univ. Sydney), St. George District Hospital, Kogarah.

Edwards, Roger Henry, M.B., B.S., 1941 (Univ. Sydney), Royal Prince Alfred Hospital, Camperdown.

Grant, Lindsay Ian Hamilton, M.B., B.S., 1941 (Univ. Sydney), 31, Elizabeth Street, Ashfield.

Hartley-Smith, Frances, M.B., B.S., 1941 (Univ. Sydney), Royal Prince Alfred Hospital, Camperdown.

Keller, Walter Lloyd Holcombe, M.B., B.S., 1941 (Univ. Sydney), Royal Prince Alfred Hospital, Camperdown.

Lane, John Charles, M.B., B.S., 1941 (Univ. Sydney), Sydney Hospital, Sydney.

Royle, Harold George, M.B., B.S., 1941 (Univ. Sydney), Royal North Shore Hospital, St. Leonards.

Schneider, Otto Henry, M.B., B.S., 1939 (Univ. Sydney), Royal Australian Air Force, No. 2 Recruiting Centre, Woolloomooloo.

Waddy, Nanette Stacy, M.B., B.S., 1941 (Univ. Sydney), Base Hospital, Tamworth.

Waugh, Peter Cedric Phipps, M.B., B.S., 1941 (Univ. Sydney), Royal Prince Alfred Hospital, Camperdown.

Williams, Owen Upcott, M.B., B.S., 1941 (Univ. Sydney), Royal Prince Alfred Hospital, Camperdown.

Diary for the Month.

FEB. 26.—South Australian Branch, B.M.A.: Branch.
FEB. 27.—Queensland Branch, B.M.A.: Council.
FEB. 27.—Tasmanian Branch, B.M.A.: Council.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Honorary Secretary, 135, Macquarie Street, Sydney): Australian Natives' Association; Ashfield and District United Friendly Societies' Dispensary; Balmain United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester Unity Medical and Dispensing Institute, Oxford Street Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phœnix Mutual Provident Society.

Victorian Branch (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

Queensland Branch (Honorary Secretary, B.M.A. House, 225, Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

South Australian Branch (Honorary Secretary, 178, North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

Western Australian Branch (Honorary Secretary, 205, Saint George's Terrace, Perth): Wiluna Hospital; all Contract Practice appointments in Western Australia.

Editorial Notices.

MANUSCRIPTS forwarded to the office of this journal cannot under any circumstances be returned. Original articles forwarded for publication are understood to be offered to THE MEDICAL JOURNAL OF AUSTRALIA alone, unless the contrary be stated.

All communications should be addressed to the Editor, THE MEDICAL JOURNAL OF AUSTRALIA, The Printing House, Seamer Street, Glebe, New South Wales. (Telephones: MW 2651-2.)

Members and subscribers are requested to notify the Manager, THE MEDICAL JOURNAL OF AUSTRALIA, Seamer Street, Glebe, New South Wales, without delay, of any irregularity in the delivery of this journal. The management cannot accept any responsibility unless such a notification is received within one month.

SUBSCRIPTION RATES.—Medical students and others not receiving THE MEDICAL JOURNAL OF AUSTRALIA in virtue of membership of the Branches of the British Medical Association in the Commonwealth can become subscribers to the journal by applying to the Manager or through the usual agents and booksellers. Subscriptions can commence at the beginning of any quarter and are renewable on December 31. The rates are £3 for Australia and £2 5s. abroad *per annum* payable in advance.